US Army Corps of Engineers
Philadelphia District

ENVIRONMENTAL ASSESSMENT

DESIGNATION OF AQUATIC DREDGED MATERIAL PLACEMENT AREAS G-EAST AND SITE 92 FOR MAINTENANCE DREDGING, INLAND WATERWAY DELAWARE RIVER TO CHESAPEAKE BAY, DELAWARE AND MARYLAND NORTHERN APPROACH CHANNEL

Prepared For:
The U.S. Army Corps of Engineers
Philadelphia District
and
The Maryland Port Administration
MPA Contract # 597919
Pin # 600105-S

Prepared By:
Maryland Environmental Service

July 1997

MARYLAND ENVIRONMENTAL SERVICE

MARYLAND PORT ADMINISTRATION

MARYLAND
ENVIRONMENTAL
SERVICE

Parris N. Glendening
Governor

James W. Peck
Director

July 28, 1997

RECEIVED
JUL 31 1997
HARBOR DEVELOPMENT

Mr. Mike Hart
Harbor Development
Maryland Port Administration
2310 Broening Highway
Baltimore, MD 21224-6621

Re: G-East/Site 92 Open-Water Placement Sites Final Environmental Assessment

Dear Mr. Hart:

Enclosed is one copy of the Final G-East/Site 92 Environmental Assessment. The copy enclosed is not complete. The FONSI and one of the Appendices is missing because the US Army Corps of Engineers, Philadelphia District is finalizing the report for reproduction and distribution. If there are any changes to the enclosed document, these will be forwarded to you as soon as they are finalized. A copy of the FONSI and missing appendix will be forwarded at a later date, once finalized.

I can be reached at 410-974-7261 with any questions or comments.

Sincerely,

James Tomlinson
For Cecelia Donovan
Environmental Services
and Waste Management Program

Enclosure

cc: Ed Dalton
Pete Kotulak
Jane Boraczek
Dick Thomas

US Army Corps
of
Engineers
Philadelphia
District

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PORT OF BALTIMORE 1706
MARYLAND PORT ADMINISTRATION

INSERT FONSI HERE

PREFACE

The Port of Baltimore is a vital component of the regional and state economy. Access to the Port by shipping interests is dependent upon the adequacy of the access channel network. The channel network is maintained and improved by dredging operations. Once removed, the dredged material must be placed in a practical, economical, technically feasible and environmentally sound manner. Availability of placement sites is a critical factor in channel maintenance and improvements. However, sufficient capacity to manage the dredged material placement need effectively may not be available beginning with the 1997-1998 dredging season unless new placement sites are made available.

The proposed open-water dredged material placement sites G-East and Site 92, located near Pooles Island in the upper Chesapeake Bay, offer a means of satisfying near-term placement needs until additional placement options specified in Maryland's *Strategic Plan for Dredged Material Management* are implemented. Senior officials of the Northeast Region of the US Fish and Wildlife Service, Region III of the Environmental Protection Agency, Northeast Region of the National Marine Fisheries Service, Baltimore and Philadelphia Districts of the US Army Corps of Engineers, and Maryland Departments of Transportation, Natural Resources and the Environment have executed a Statement of Cooperation to facilitate the implementation of strategic plan elements, including expansion of open-water placement in the Pooles Island area, consistent with applicable State and Federal laws. A wide range of alternatives to continued use of the Pooles Island area for open-water placement have been examined through the Dredging Needs and Placement Options Program sponsored by the Maryland Port Administration, but none have proven capable of implementation in time to satisfy near-term placement needs for maintenance of the Chesapeake and Delaware Canal northern approach channels between Grove Point and Tolchester.

Existing placement sites in the Pooles Island area have been the subject of extensive environmental documentation and monitoring. The salient environmental and economic aspects of this area have been examined, and the impacts from use of the new sites for dredged material placement have been detailed. Coordination efforts and the action's relationship to existing regulations and programs have been outlined.

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GLOSSARY OF TERMS

ANADROMOUS: requiring fresh water and/or rivers to spawn; fish that migrate up rivers from the sea to breed in fresh water.

ANOXIC: without oxygen or in oxygen deficit.

APG: Aberdeen Proving Grounds; military facility located in Harford and Baltimore Counties, Maryland on the western shore of the upper Bay, west and northwest of Pooles Island.

AVIFAUNA: referring to birds.

BATHYMETRY: depth measurement and bottom characterization of oceans, seas, etc.

BENTHIC: living in, on, or in close association with the bottom of a body of water.

BERM: a protective ridge or ledge usually associated with guiding or restricting surface flow.

BIOMASS: total mass of living organisms (cf. numbers of individuals).

CATADROMOUS: requiring high salinity and/or an ocean environment for spawning; fish that migrate down river to breed in marine waters.

CBMP: Chesapeake Bay Monitoring Program established by CBP.

CBP: Chesapeake Bay Program. A unique, regional, federal-state-local partnership which directs and coordinates the Chesapeake Bay restoration.

C&D CANAL NORTHERN APPROACH CHANNELS: includes all channels north of Tolchester channel.

C&D CANAL SOUTHERN APPROACH CHANNELS: includes Tolchester channel and all channels south; Brewerton, Craighill, and Swan Point channels (in Maryland waters).

CENAB: US Army Corps of Engineers, Baltimore District.

CFS: cubic feet per second.

CHARTER BOAT generally operates daily, typically licensed to carry a maximum of 6 persons, fee collected typically for the entire boat.

CLAY: sediment grains less than 2 microns (0.002 mm) in diameter, often colloidal in nature.

COHORT: a group of fish spawned during a given period, usually within a year.

COLONIAL: non-species specific congregations.

CONFLUENCE: location where two flows such as from a river, stream or current meet and unite.

CPUE: catch-per-unit-effort. A term used in fisheries science that represents the number of fish caught by an amount of effort. Typically, effort is a combination of gear type, gear size, and length of time gear is used. CPUE is often used as a measurement of relative abundance for a particular fish.

CRUST MANAGEMENT: a site management practice performed to maximize the dredged material storage capacity gained by continued drying and consolidation of dredged material. Dewatering of the dredged material can be accelerated by additional dewatering techniques, for example trenching.

CY: cubic yards.

DAMPING: checking; restraining; reducing the amplitude of something.

DEWATERING: the process of drying dredged material placed in upland or containment sites.

DIEL: of or pertaining to a 24 hour cycle.

DIURNAL: daily; specifically referring to things which are of or pertaining to the daytime. Diurnal tide refers to a system that has two tides per day, a high and a low.

DIVERSITY: measure of variety in a biotic community; has specific statistical identity and meaning.

DIVIDERS: incremental rings that originate from Pooles Island Light and expand outward (similar to a bulls-eye) until they encompass the furthest access points.

DMMP: the Governor's *Strategic Plan for Dredged Material Management.*

GLOSSARY OF TERMS (continued)

DNPOP:	Dredging Needs and Placement Options Program; sponsored by MPA and facilitated by MES; established to address channel placement needs of the Port and associated channel systems in Maryland.
DRAFT:	the depth of water that a ship displaces (especially when loaded); the distance from keel to waterline.
EFFLUENT:	something that flows out; something that is discharged from an outfall, typically referring to liquid discharge.
Eh:	a measure of the chemical environment (oxidizing or reducing) at a specific depth in the sediment column measured relative to a calomel electrode.
EPA:	Environmental Protection Agency.
ESTUARY:	inlet of the sea where fresh river flows and saline tidal masses meet and interact.
EUPHOTIC ZONE:	the "lighted zone" within an aquatic system; the portion of the water column that receives light from the surface and in which photosynthetic processes can occur.
EURYHALINE:	able to tolerate a wide range, wide fluctuations, in salinity.
EUTROPHICATION:	enrichment with nutrients causing increased phytoplankton growth and decreased oxygen concentrations in summer months.
FLUVIAL:	pertaining to rivers; produced by river action.
FONSI:	Finding of No Significant Impact. Authorization to initiate a project once an EA has been completed and an EIS was determined to not be necessary to fulfill the requirements of the National Environmental Protection Act (NEPA).
FRESHET:	a surge of fresh water in a river system, usually occurring in the spring, resulting from heavy precipitation in the drainage basin combining with snow melt.
GMS:	Department of Defense Groundwater Modeling System.
GRAVITATIONAL CIRCULATION:	normal movement of water in an estuary exclusive of tidal currents; Density differences between fresh water and sea water induce seaward movement of fresh water at surface and landward movement of salt water at bottom; also called "estuarine circulation".
HABITAT:	place where a living thing is usually found; not specific to life-stage.
HEAD BOAT:	operates daily during the fishing season and charges generally per individual rather than as a charter party.
HMI:	Hart-Miller Island
HYDRAULIC DREDGING:	method of dredging that mixes water with excavated sediment so that it can be pumped.
HYPOXIC:	having oxygen concentrations less than 1 mg/l.
ICHTHYOPLANKTON:	fish life stages that are of planktonic character.
IN SITU:	Latin term meaning in place, especially in natural or original position.
LIMNETIC:	living away from the vegetated shores of fresh water bodies.
LITTORAL:	of, on or along the shore; region along the shore.
LL:	liquid limit; one of the designations from the Atterberg limits. Atterberg limits are the collective designation of so-called limits of consistency of fine-grained soils suggested by Albert Atterberg.
MACROINVERTEBRATE:	organisms > 0.5mm possessing no internal skeleton.
MCM:	million cubic meters.
MCY:	million cubic yards.
MDE:	Maryland Department of the Environment.
MDNR:	Maryland Department of Natural Resources.
MDOT:	Maryland Department of Transportation.
MES:	Maryland Environmental Service.
MESOHALINE:	salinity of 5.0-18.0 parts per thousand.
MGS:	Maryland Geological Service, a division of MDNR.

GLOSSARY OF TERMS (continued)

MHT:	Maryland Historical Trust.
MICROTIDAL:	having a 0 - 2 meter tidal range.
MLLW:	mean low-low water; mean low water (MLW) is the average of all low tides in a diurnal tide system. MLLW is the average of the lower ½ of the low tides calculated for MLW.
MPA:	Maryland Port Administration.
MRFSS:	Marine Recreational Fisheries Statistical Survey.
MSSA:	Maryland Saltwater Sportfisherman's Association.
NMFS:	National Marine Fisheries Service.
MD NOAA Code 025:	Maryland NOAA Code 025 area extends from the Chesapeake Bay Bridge to just north of Pooles Island.
NOEL:	no observed effect limit; a toxicology term referring to the concentration of a parameter at which no toxic effect has been observed.
NOS:	National Ocean Service.
NUTRIENT:	non-organic compound of nitrogen, phosphorus or silica used as food by organisms, specifically plants.
PEL:	probable effects level; a toxicology term referring to the level at which toxic effects are probable.
PL:	plastic limit; one of the designations from the Atterberg limits. Atterberg limits are the collective designation of so-called limits of consistency of fine-grained soils suggested by Albert Atterberg.
OLIGOHALINE:	salinity of 0.5-5.0 parts per thousand.
OPEN-WATER PLACEMENT:	subaqueous placement of dredged material utilizing hydraulic, bottom release scow, or similar placement techniques.
ORIGINAL G-EAST:	initial G-East concept area recommended by DNPOP. This site was approximately 375 acres, had an approximate capacity of 1.5 mcy when brought to elevation -16 feet MLLW, and included an area of high relief within the northeastern edge of the site. Site boundaries can be found in Section 1.3.1.
ORIGINAL SITE 92:	initial Site 92 concept area. This site was approximately 252 acres. Site boundaries can be found in Section 1.3.2.
OTOLITH:	ear stones located within the inner ear of a fish. In certain fish species the otoliths are utilized for taxonomy.
OVERBOARD:	see Open-Water Placement.
PCOE:	US Army Corps of Engineers, Philadelphia District.
PELAGIC:	of open waters (littoral).
PHYTOPLANKTON:	plants of planktonic character.
PISCIVOROUS:	preying upon fish; fish-eating.
PLANKTON:	usually microscopic life floating or drifting in water bodies.
PRIMARY PRODUCTIVITY:	formation of organic matter in a system by means of photosynthetic processes in green plants.
RECONFIGURED G-EAST:	site was reconfigured to avoid an area of high relief within the northeastern edge of the original concept area because of results of a striped bass angling survey. The site is approximately 281 acres in size and provides 1.2 mcy of capacity when brought to elevation -16 feet MLLW. Site boundaries can be found in Section 2.2.5.3.
RECONFIGURED SITE 92:	concept area was reconfigured to expand capacity. The site is approximately 934 acres and would be brought to elevation -14 feet MLLW. Site boundaries can be found in Section 2.2.5.4.
RECRUITMENT:	a measure of the number of fish that enter a class during some time period, such as the spawning class or fishing-size class.
RIPARIAN:	relating to the bank or shoreline of a body of water.

GLOSSARY OF TERMS (continued)

RIVERINE: of or having to do with a river.

SALINITY: measure of salt content; expressed as parts per thousand (ppt).

SALINITY STRATIFICATION: layering that occurs in the water column due to the different densities of fresh and salt water; density difference causes the two fluids to maintain themselves as separate water masses with denser saltwater overlain by freshwater.

SAND: sediment grains ranging from 62 microns (0.062 mm) to 2 mm in diameter.

SAV: submerged aquatic vegetation; vascular plants that live and grow completely underwater or just up to the water surface.

SEDIMENT PARTICULATE CARBON: percentage by dry weight of particulate organic carbon for a specified section of the sediment column (PC).

SEDIMENT PARTICULATE NITROGEN: percentage by dry weight of particulate organic nitrogen for a specified section of the sediment column (PN).

SEMI-DIURNAL: 12 hour cycle or period (see DIURNAL).

SHOALING: creation of shallow places such as sandbanks or sand bars in a sea, lake or river through natural processes of sedimentation.

SILT: sediment grains ranging in size from 2 microns (0.002 mm) to 62 microns (0.062 mm).

SHEAR STRENGTH: measure of stability under applied lateral forces; the internal resistance offered to shear stress.

SHEAR STRESS: a stress causing or tending to cause two adjacent layers of a solid to pass one another parallel to the plane of contact.

STAGING: a stopping and resting place for birds during migration.

SUBSTRATE: ground or bottom structure and character, particularly as it relates to animals and plants that grow and feed on it.

SUSPENDED SEDIMENT: filterable solids suspended in a fluid; does not include dissolved solids.

TURBIDITY: measure of colloidal and suspended particles in water; measured in Turbidity Units.

UBCBCA: Upper Bay Charter Boat Captains' Association.

UMCEES: Chesapeake Biological Laboratories. Part of the University of Maryland Center for Estuarine and Environmental Studies located in Solomons, Maryland.

USFWS: US Fish and Wildlife Service.

UXO: unexploded ordnance; ammunition that has been fired and has contacted ground without detonating. In the Chesapeake Bay region, this ordnance is typically buried and is therefore not an explosive danger until it is disturbed by activities such as dredging or placement.

WES: US Army Corps of Engineers, Waterways Experiment Station.

WHD: Wildlife and Heritage Division of MDNR.

ZOOPLANKTON: animals of planktonic character.

1. PROJECT INTRODUCTION, HISTORY AND PURPOSE AND NEED

1.1. PROJECT INTRODUCTION

Channel maintenance and improvement to the Chesapeake and Delaware (C&D) Canal northern approach channels, located in the upper Chesapeake Bay, requires the removal of up to 1.5 million cubic yards (mcy) (1.2 million cubic meters [mcm]) of material annually. Placement options for this material have traditionally included open-water placement, specifically in the areas around Pooles Island. In the 1997/1998 dredging season, currently permitted placement areas for material from the northern approach channels are projected to be at or near capacity. Additional placement capacity must be identified in order to continue to maintain the channels, enable future improvements, and to manage the dredged material placement more effectively.

Two placement areas are assessed in this document. One area involves expansion of the dredged material placement area currently known as Pooles Island Area G. It is proposed that Area G be expanded to include G-East. The other area is to the south of the currently permitted placement area G-Central, includes a portion of G-South, and is designated as Site 92. This Environmental Assessment (EA) has been prepared to assess the potential environmental effects associated with designation of G-East and Site 92 as open-water placement sites in the upper Bay. The EA has been prepared in accordance with the National Environmental Policy Act (NEPA) (1969).

The ongoing Dredging Needs and Placement Options Program (DNPOP), which is sponsored by the Maryland Port Administration (MPA) and facilitated by the Maryland Environmental Service (MES), is currently addressing the channel placement needs for maintenance within the Port of Baltimore (the Port) and for associated channel systems as well as channel improvements. The DNPOP findings have been incorporated into the Governor's *Strategic Plan for Dredged Material Management* (DMMP) (MPA, 1996) and into a formal statement of cooperation regarding use and placement of dredged material in the Maryland portion of the Chesapeake Bay (MDOT, 1996). Senior officials of the Northeast Region of the US Fish and Wildlife Service (USFWS), Region III of the Environmental Protection Agency (EPA), Northeast Region of the National Marine Fisheries Service (NMFS), Baltimore and Philadelphia Districts of the US Army Corps of Engineers (CENAB and PCOE, respectively), and Maryland Departments of the Transportation (MDOT), Natural Resources (MDNR) and the Environment (MDE) have executed the Statement of Cooperation to facilitate the implementation of strategic plan elements, including expansion of open-water placement in the Pooles Island area, consistent with applicable State and Federal laws.

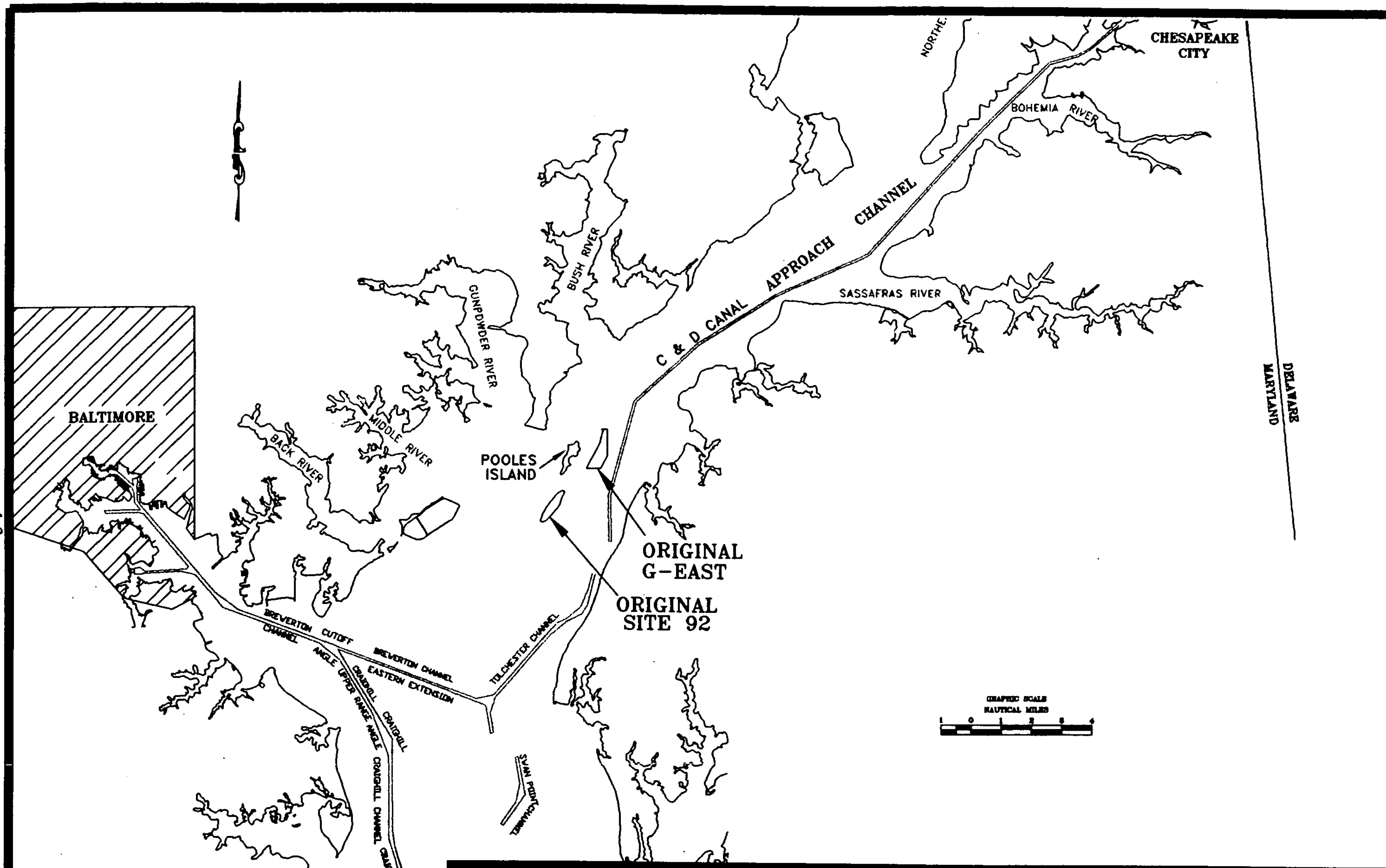
New open-water placement sites are needed to accommodate maintenance dredging as well as additional material resulting from important channel improvement projects such as the Tolchester and Brewerton Channel improvements. Expansion of the Pooles Island sites is essential to accommodate the immediate need for additional placement capacity for the C&D Canal northern approach channels. The Pooles Island area was chosen to provide the additional near-term capacity because of the extensive data already available including ongoing environmental monitoring of G-West and G-South and because of its location in proximity to the channel reaches for which placement capacity is urgently needed. If approved for placement, G-East and Site 92 would provide up to 4.9 mcy (3.8 mcm) of capacity. Capacity in this range will satisfy the minimum requirements for the corresponding component of the Governor's DMMP. Any capacity obtained above 4.5 mcy (3.5 mcm) is desirable as a contingency for exceptional shoaling resulting from episodic storms.

1.2. DREDGING AND PLACEMENT HISTORY

The C&D Canal northern approach channels in the upper Bay are a major shipping route for access to the Port. Channel dimensions for new or improved channels (referred to as new-work) are specified according to need, authorized by Congress, funded through federal appropriations and local cost shares, and constructed. Natural processes of sediment transport and sedimentation then deposit sediments in the channels at varying depths. These sediments are removed through periodic "maintenance dredging" in order to maintain channels at prescribed widths and depths, in the interest of navigation safety.

The designation of placement areas for the material removed from the northern channels is an integral part of dredged material management. Both upland and open-water sites have been used historically as placement options in the Chesapeake Bay. The first documented use of an open-water site for the C&D Canal northern approach channels is associated with the 1936-1938 new-work dredging of the 27-foot (8.2 m) deep by 400-foot (122 m) wide approach channel from the C&D Canal southward to the vicinity of Pooles Island (Figure 1-1). Four government-owned hopper dredges were employed. The hoppers were loaded with material taken from the area now described by the channel reach between Pooles Island (south end) and the Elk River (north end). The documented volume for this operation was 24.2 mcy (18.6 mcm) (Gebert, 1991).

After removal, portions of the new-work volume of material were placed in upland containment sites (50-60%) and portions were placed in open-water sites (40-50%). The dredged material taken from the reach between Pooles Island and the Sassafras River was placed in open-water 1,509 feet (460 m) outside the easterly and westerly limits of the channel. Available records indicate that historically, most of the material placed in open-water was placed to the east of the channel (Gebert, 1991).



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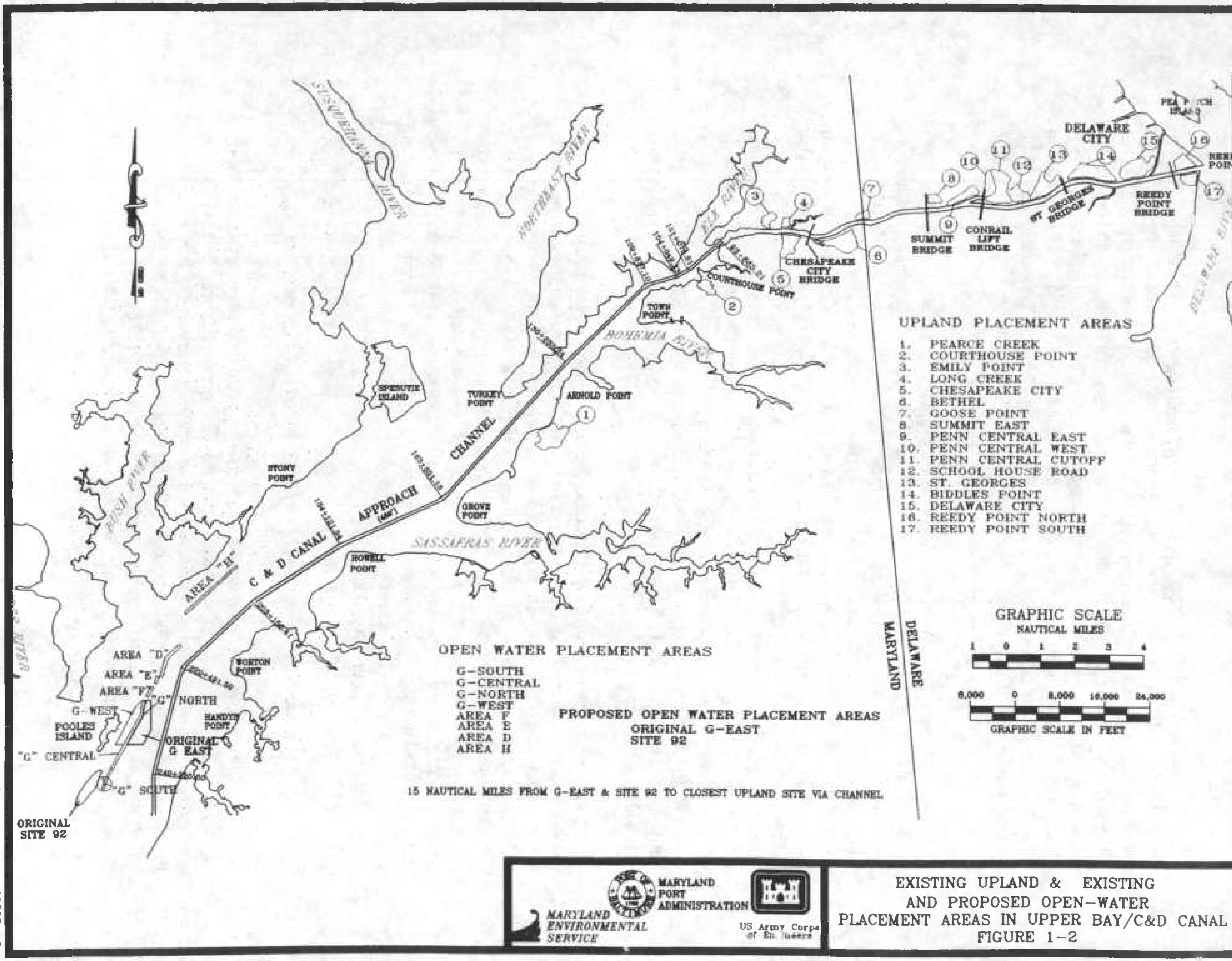
C&D CANAL AND PORT OF BALTIMORE APPROACH CHANNELS AND PROPOSED G-EAST AND SITE 92

FIGURE 1-1

From 1938 to 1960, the channel reaches between Pooles Island and Elk River were dredged periodically to maintain the authorized project depth (Gebert, 1991). Over the twenty year period between 1940 and 1960, the *in situ* volume of the material removed through maintenance dredging averaged 0.4 mcy per year (0.3 mcm/yr). No maintenance work was recorded for two years after the completion of the new-work in 1938. The amount of material placed in open-water sites associated with maintenance from 1940 to 1960 is uncertain. A report from the Committee on Tidal Hydraulics (1965) states that "all disposal was placed overboard [open-water sites]", while a Philadelphia District, Army Corps of Engineers (PCOE) Operations and Maintenance report indicates that the placement practice was in a like manner to the new-work operations, which included upland placement. As noted above, construction of the 27-foot (8.1 m) channel sent approximately half of the material to upland containment sites and the balance to open-water sites. If this practice was continued during maintenance between 1940 and 1960, approximately half of the extracted material would have been placed in open-water sites 1,500 feet (450 m) east or west of the channel, predominantly to the east.

The approach channel between Pooles Island and the Sassafras River was deepened to 35 feet (10.7 m) between 1965 and 1968. A southern four to five mile (6-8 km or 3.5-4.3 nautical mile) section adjacent to and northeast of Pooles Island was the first section dredged. The volume of material removed from this section was 4.2 mcy (3.2 mcm). All of this material was placed in an area roughly equivalent to currently defined Areas E, F, G and the southern portion of Area D (Figure 1-2) (Halka and Panageotou, 1992). The section of channel just west of the mouth of the Sassafras River was the second reach deepened. The reported quantity of 1.9 mcy (1.5 mcm) was placed in open-water at a location 4,002 feet (1,220 m) northwest of the channel. Dredging of the last channel section located between the Sassafras River and a point northeast of Pooles Island in 1967-1968 generated an additional 5.7 mcy (4.4 mcm) of material. This material was placed in open-water sites. It is believed that a portion of the material was placed in previously designated Areas A, B and C which were located parallel to the channel and north of Area D, and a portion was placed in the northern portion of Area D (Halka and Panageotou, 1992).

Since 1977, annual routine maintenance dredging of the C&D Canal northern approach channels has resulted in open-water placement of an average *in situ* sediment volume of approximately 1.2 mcy, (0.9 mcm) not including advance channel maintenance. This volume has been raised to 1.5 mcy (1.2 mcm) in order to enable advance maintenance dredging so that channels remain below prescribed depths between dredging cycles. This material has been placed in designated Areas D, E, F, G and H (Figure 1-2). The total maintenance volumes are slightly higher, as some maintenance material was sent to other sites (Halka and Panageotou, 1992).



EXISTING UPLAND & EXISTING AND PROPOSED OPEN-WATER PLACEMENT AREAS IN UPPER BAY/C&D CANAL
FIGURE 1-2

D:\POOLES\DRWG\CDMAP.DWG

Maintenance of the northern approach channels to the Port and material dredged from the C&D Canal northern approach channels have contributed to the use of the Pooles Island open-water placement sites. Dredging of the Swan Point and Tolchester Channels during 1980/1981 resulted in the placement of material in G-Central. Brewerton Eastern Extension Channel material was placed in G-North in 1990. Tolchester Channel maintenance material was placed in G-Central and G-South in 1991/1992. Dredged material from the maintenance of Craighill Channel, Swan Point Channel and the Cut-Off Angle were also placed in G-Central and G-South during 1992/1993 (Gebert, 1991).

G-West was utilized for placement from 1993 to the present. Southern berm creation was completed in the 1993/1994 operations window and resulted in approximately 529,652 cy (0.4 mcm) of dredged material being placed along the southern edge of G-West (MES, 1995b). Hydraulic placement in G-West for the 1994/1995 placement operations was estimated at 1,014,186 cy (0.8 mcm) of material placed between November and December 1994 (PCOE, 1995). Placement also occurred at Area E&F during the 1994/1995 season, totaling 369,694 cy (0.3 mcm). During 1995/1996 placement operations, dredged material placement in G-West totaled 693,922 cy (0.5 mcm) and 202,396 cy (0.2 mcm) in Area F (PCOE, 1997a). During the 1996/1997 placement operations, dredged material was placed in G-South and along the G-West berms, which includes portions of G-Central and G-North. Placement at the G-West berms totaled 1,084,189 cy (0.8 mcm) and placement in G-South totaled 718,943 cy (0.5 mcm) (PCOE, 1997b).

Although historical placement records are incomplete, an estimated 50-55 mcy (38-42 mcm) of material has been dredged from the C&D Canal approach channels in the upper Bay since the approach channels were deepened to 27 feet (8.1 m) in the mid-1930's. Records prior to 1965 indicate open-water placement was within about 1500 feet (450 m) of the channels. All of the presently designated sites are further from the channel than 1500 feet (450 m), and are not known to have received dredged material prior to 1965. During deepening of the approach channels in 1965-1968, much of the material placed within the open-water sites is encompassed by currently designated sites. All open-water placement of maintenance dredging material since 1977 has occurred within designated Areas D, E, F, G and H (Gebert, 1991).

1.3. G-EAST AND SITE 92 CONCEPT ORIGINATION

In 1990, Governor William Donald Schaefer of Maryland appointed a multi-organization Task Force to research and make recommendations regarding the management of dredged material to ensure the continued vitality of the Port. The Task Force recommended, in addition to other recommendations, continued use of Pooles Island sites to fulfill short-term and long-term needs (recommendations 7.2 and 15) and studies for future use of open-water sites (recommendation 17) (MDOT, 1991). In

1992, the DNPOP program was established by the MPA and the MES, under the MPA's sponsorship, to implement the task force recommendations. The DNPOP program represents a broad base of interests, missions and specialties. Representation is from federal, state, and local governments, members of the academic community, environmental interest groups, maritime commerce interests, groups who depend on the health of the Chesapeake Bay for their livelihood and citizen groups. The input of all agencies with missions involving channel maintenance, identification of potential placement sites, maintenance and monitoring of Bay water quality and management of natural resources was applied to implementing the task force recommendations. In addition to the need for sufficient capacity for projected dredging requirements, concerns regarding such topics as habitat and water quality were considered. The findings and recommendations of DNPOP activities were incorporated into the Governor's DMMP (MPA, 1996).

The Governor's DMMP recognizes the immediate need for additional capacity for projects such as maintenance of the C&D Canal, improvements and widening of the Tolchester and Brewerton Channels, and improvements to channels and anchorages within the Port. These projects were identified as critical to maintaining navigation safety and the competitive position of the Port. G-East was identified through DNPOP activities and specified for further study. Site 92, an option from MPA's Master Plan initiative, was found to be outside of areas screened by state and federal resource agencies as having significant habitat value. It was added to this assessment in response to concerns expressed by resource agencies, charter boat captains and the Maryland Salt-Water Sport Fishermen's Association (MSSA) about use of G-East for placement. These agencies and organizations requested that Site 92 be added as an alternative to G-East. Subsequent studies revealed that use of both sites was estimated to provide the capacity designated in the Governor's DMMP.

1.3.1. Boundaries of Original G-East

The original site was east of Pooles Island and placement areas G-North and G-Central and west of the C&D Canal northern approach channels, outside the jurisdiction of the US Army Aberdeen Proving Ground (APG) (Figure 1-3). The original G-East concept area was approximately 375 acres (1,527,750 m^2) and the boundaries were as follows:

Beginning at the northeastern-most point at 39 17 59.00N, 076 14 16.90W,
Running thence to 39 17 05.30N, 076 14 17.44W,
Running thence to the southeastern-most point at 39 16 39.63N, 076 14 35.28W,
Running thence to the southwestern-most point at 39 16 39.81N, 076 15 11.81W,
Running thence northeast to 39 17 32.02N, 076 14 34.60W,

Running thence to 39 17 52.61N, 076 14 29.85W,
Running thence to 39 17 55.84N, 076 14 26.89W,
Running thence west to 39 17 59.20N, 076 14 31.12W,
and running thence to the point of beginning.

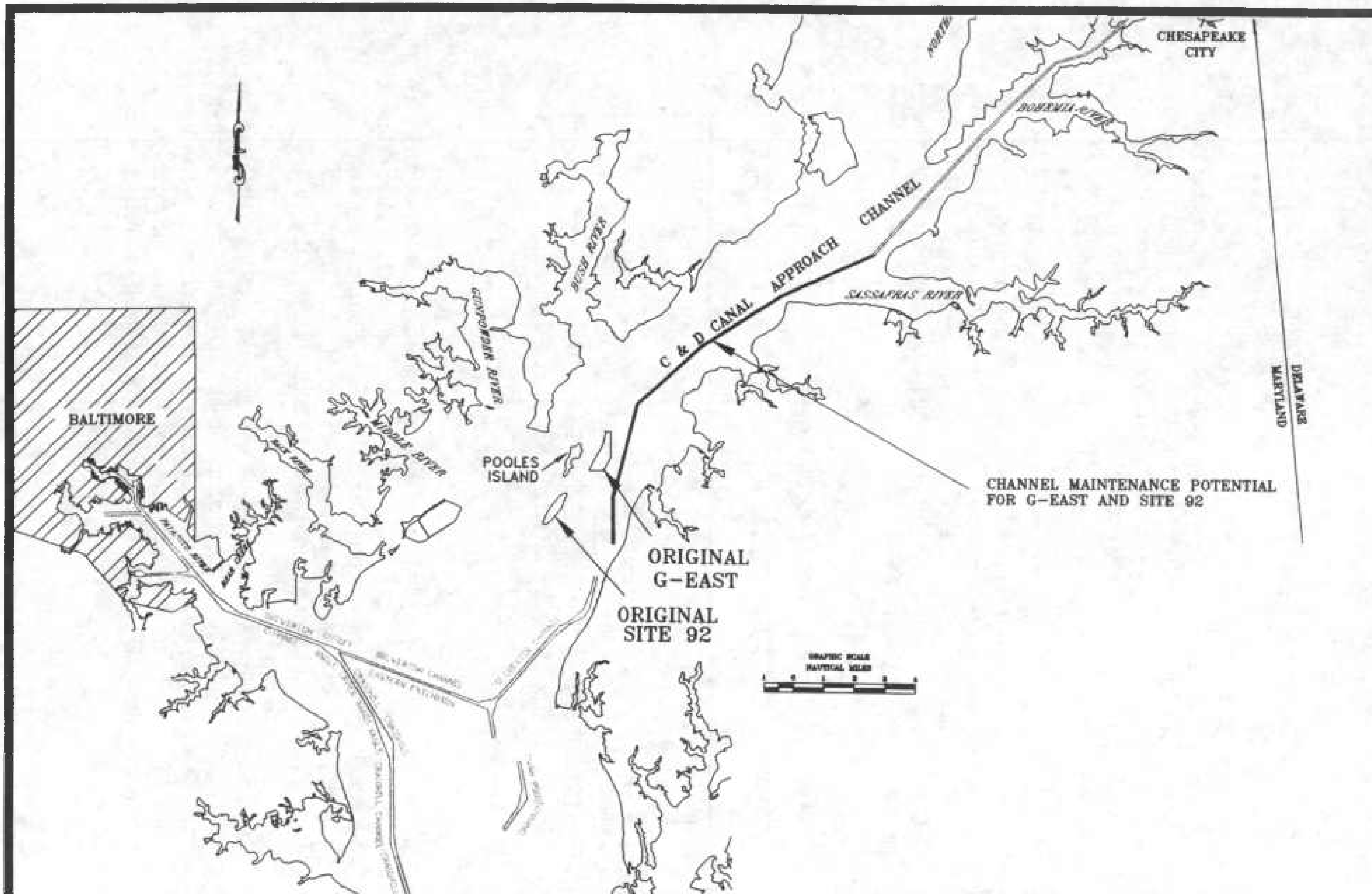
Due to fisheries-related concerns, G-East was reconfigured to exclude an area of high relief located within the original site boundaries. This area of high relief was in the northern portion of the original site. Refer to Section 2.2.5.3 for details on the reconfigured site.

1.3.2. Boundaries of Original Site 92

The original site was south of Pooles Island and west of the C&D Canal northern approach channels, outside the jurisdiction of the US Army Aberdeen Proving Ground (APG) (Figure 1-3, The original Site 92 concept area was approximately 252 acres (1,019,844 m^2) and the boundaries were as follows:

Beginning at the northeastern end of the site at 39 15 53.27N, 076 16 08.78W,
Running thence southwest to 39 15 37.99N, 076 16 16.80W,
Running thence southwest to 39 15 22.04N, 076 16 24.70W,
Running thence southwest to 39 14 55.69N, 076 16 53.75W,
Running thence southwest to 39 14 51.25N, 076 17 05.19W,
Running thence northwest to 39 14 53.15N, 076 17 08.83W,
Running thence northeast to 39 15 05.36N, 076 17 05.29W,
Running thence northeast to 39 15 29.72N, 076 16 47.08W,
Running thence northeast to 39 15 48.97N, 076 16 26.24W,
Running thence northeast to 39 15 54.20N, 076 16 12.59W,
and running thence to the point of beginning.

Due to placement needs and the limited number of potential placement sites, Site 92 was reconfigured to provide additional capacity and to expand the project area. The reconfigured site did not impact high relief areas to the northeast. Refer to Section 2.2.5.4 for details on the reconfigured site.



MARYLAND ENVIRONMENTAL SERVICE

MARYLAND PORT ADMINISTRATION

US Army Corps of Engineers

CHANNEL MAINTENANCE POTENTIAL FOR G-EAST AND SITE 92 PROPOSED PLACEMENT AREAS
FIGURE 1-3

1.4. PURPOSE AND NEED FOR THE PROJECT

The C&D Canal with its network of connecting channels, provides access to the Ports of Baltimore, Philadelphia, Wilmington and New York as well as the European trade routes. Sufficient shipping is conducted through these ports to necessitate an enormous network of transportation facilities including rail, air and trucking. The C&D Canal system is a vital and integral part of the economy of the Northeast Corridor, and the nation as a whole.

A high percentage of the C&D Canal traffic originates at, or is destined for, the Port of Baltimore. The Port is considered one of the leading car-carrier ports in the US and major cargo handling facilities exist at the Dundalk, Seagirt, Locust Point, Hawkins Point and Clinton Street Terminals, representing an investment of $500,000,000. Table 1-1 below summarizes the dollar value of the economic benefits generated by the Port (MPA, 1996).

Table 1-1: Economic Benefits Generated by the Port of Baltimore

Port of Baltimore		% of Ships Utilizing C&D Canal*
Employment Total No. of Jobs Direct Jobs	 62,500 18,000	 Inbound 33
Economic Activity- annual	$2 billion	
State and Local Taxes- annual	$141 million	Outbound
U.S. Customs Receipts-annual	$400 million	25

* from C&D Canal EIS (PCOE, 1996).

The Corps of Engineers has the mission and authority to maintain navigation channels in the interest of safe navigation, and to do so in a thorough manner to ensure compliance with authorized channel dimensions and federal navigation projects. It is essential that, as part of a dredging management program, there is sufficient capacity for placement of material removed during channel maintenance operations.

Currently, there are seventeen upland sites under Federal ownership that are used in conjunction with maintenance dredging of the C&D Canal proper, southward through Elk River to the confluence of the Chesapeake Bay and the Sassafras River. These sites (Figure 1-2) are strategically located to provide placement capacity for various sections of the C&D Canal proper, and northern approach channels as needed.

Due to long pumping and handling distances to upland placement areas, dredged material taken from south of the Sassafras River down to deep water south of Pooles Island has been placed into eight designated open-water sites in the vicinity of Pooles Island (Figure 1-2). In addition to long pumping and handling distances (approximately 15 miles to the nearest site; Figure 1-2), use of the upland sites for this material would reduce long-term capacity at these sites, which is needed for material dredged from the northern-most approaches and the Canal itself and is not an acceptable alternative. Also, use of the existing upland sites for placement of this material would require substantial additional funding that is economically impractical and thereby, detrimental to the vitality of the Port.

A review of available capacity in existing or previously used open-water placement areas in the vicinity of Pooles Island was performed. Bathymetric surveys have shown that Areas D, E and F have been filled to the point where additional deposition of dredged material would not likely remain within the controlled boundaries. Area H, which is the only site where prediction and delineation of placed sediments was not possible, is not available as a dredged material placement site due to concerns over material dispersion and possible effects on fisheries, especially because of its location within the state-designated striped bass (*Morone saxatalis*) spawning reach. G-Central and G-North had residual capacity, of which portions immediately adjacent to G-West were utilized during 1996/1997 placement operations to maintain the G-West berms. G-South has some residual capacity, a portion of which was utilized during 1996/1997 placement operations for additional placement capacity. The remaining capacity in G-South is considered part of the Site 92 capacity. G-West is projected to be at or near full capacity by the end of the 1997/1998 dredging season. Approximately 1.1 mcy was placed during 1996/1997 due to accelerated shoaling in the navigation channels following recent episodic storms. Therefore, G-East and Site 92, which are proposed for placement no sooner than the 1997/1998 season, are necessary because of the need for available placement sites in the vicinity of the C&D Canal northern approach channels.

G-East and Site 92 are vital to the dredged material management plan as placement sites. These sites are necessary to address the expected material that will be dredged from the C&D Canal northern approach channels continued maintenance (Figure 1-3) (PCOE, 1996). Without placement sites, maintenance operations for the C&D Canal would need to be put on hold until additional placement options had been investigated and established. If channel improvements were not undertaken, this would have a variety of repercussions on the commerce activity of all ports along the intercoastal waterway (PCOE, 1996).

2. ALTERNATIVE PLANS

2.1. NO ACTION ALTERNATIVE

The existing designated dredged material placement sites for C&D Canal northern approach channel maintenance materials have been exhausted or are already committed to scheduled dredging activities. The existing Pooles Island open-water sites are currently at capacity, no longer feasible as placement sites, or are projected to be at or near capacity by Fall 1997. G-West is projected to be at or near capacity by 1997 or 1998. G-South was utilized during the 1996/1997 placement operations and most of the remaining capacity is being considered part of Site 92. Continued maintenance dredging is scheduled to commence in Fall 1997. Without sites to accept material, dredging the federally-maintained navigation channels to authorized project depths would have to be severely curtailed or delayed until sufficient placement capacity is identified, delineated assessed and permitted.

The search for placement sites which are environmentally acceptable, economically practicable and technically feasible from an engineering perspective is an ongoing process under DNPOP. Many placement options have been identified and screened for suitability. A full range of options have been considered including traditional within-region open-water placement, upland containment, use of dredged material as a natural and economic resource (i.e., "beneficial use"), reclamation of quarries and sand and gravel pits, ocean placement and creation of artificial island containment facilities. The most promising of the placement options continue to be subjected to comprehensive assessments.

The only options that have emerged as having potential to provide new capacity for the near-term maintenance of northern C&D Canal approach channels between Grove Point and the Tolchester S-turn by Fall 1997 are the Pooles Island G-East and Site 92 options. Other options which had been planned for this channel reach have not proven to be implementable, including a proposed beneficial use project at Worton Point and habitat restorations and shoreline stabilization projects within APG, as discussed in Section 2.2 of this report. All other options under investigation through DNPOP will not provide new capacity for the northern C&D Canal approach channels for at least 4 to 6 years. The project to increase capacity of the Hart-Miller Island Dredged Material Containment Facility will not provide capacity for maintenance of the C&D Canal northern approach channels without subtracting capacity designated for other channel dredging projects and without substantially exceeding the annual placement potential of the facility, thereby reducing its overall capacity.

During the no action period, channel depths would steadily decrease, thereby inhibiting access by deep-draft vessels that use these routes and increasing risk to navigation safety without a corresponding reduction in cargo-carrying capacity in order to reduce vessel draft. In the extreme, some deep draft vessels that currently use the C&D Canal may not be able to access it at all, due to drafts or handling characteristics in shallow water. However, the reduction in cargo-carrying capacity by itself is sufficient to induce a significant decline in commerce activity because maritime commerce is conducted on a very small economic margin. The combined effect of nonavailability of the channels to some vessels, increases in transportation costs and loss of economic productivity through increased transit times would necessitate or result in a bypass of this important transportation route for some maritime commerce. This bypass would affect use, to varying degrees, of mid-Atlantic and Southeastern U.S. ports because of the intense competition among these port regions. The Port, because of its location in the upper reaches of the Chesapeake Bay Estuary, would receive an especially hard impact if transit times, costs and distances were increased by forcing commerce to access the port through the mouth of the Chesapeake Bay. The competitive balance among the mid-Atlantic ports would be altered with significant adverse impacts to the Port's ability to compete.

Placement options are a vital component of dredging programs. A no action plan is not viable in the interest of maintaining a strong East Coast port system to serve national interests in maritime commerce. Furthermore, the Port directly and indirectly contributes about 10 percent or more of the State of Maryland's economy and is part of the heart of the Eastern Seaboard regional economy. Economic effects felt in this port will have nationwide economic reverberations. It is in the national interest to maintain the navigation infrastructures necessary for a productive Port. Therefore, the no action alternative is unacceptable.

2.2. OTHER ALTERNATIVES

A large number of alternatives have been identified through DNPOP and screened for environmental, economic and engineering suitability. A number of privately-owned properties have also been identified and preliminarily evaluated through the DNPOP program and other studies by the MPA, MES, the MDNR and PCOE. Few of these options have been found to be feasible and fewer still with the broad base of support needed to enable near-term implementation. With the exception of Dobbins Island, which proved to be impractical as a placement option for the Port due to citizen concerns, technical limitations and because it was an uneconomical option, consideration of the options that have been identified is continuing as possible future alternatives. However, near-term implementation of these alternatives is not feasible, primarily because of environmental issues and lack of public support, and in the case of sites within APG waters, unresolved liability issues about "Superfund" sites and the widespread presence of unexploded ordnance (UXO) from firing activities. Subsequently, in August 1995, participants in the DNPOP program concluded that the options that had been under consideration to provide for all of the Port's near-term placement needs were encountering difficulties in implementation and would not be available in time to meet dredging needs. The problem would be particularly acute for the C&D Canal northern approach channels because all planned placement options were found to not be capable of near-term or mid-term implementation. The DNPOP effort was redirected to consider technically feasible placement alternatives that had previously been institutionally constrained. This effort involved extensive interagency scoping and screening activities and extensive public involvement. A six-point dredged material management plan was developed, refined and publicly announced by Governor Parris Glendening on September 5, 1996, as the DMMP (1996). This plan includes the following placement options:

- expansion of open-water capacity at Pooles Island;
- expansion of capacity of the North Cell at the Hart-Miller Island Dredged Material Containment Facility;
- restoration of Poplar Island;
- reactivation of the CSX and Cox Creek containment cells;
- placement of materials in various open-water placement sites; and
- construction of a major placement facility in the upper Bay north of the Bay Bridge or near the mouth of the Patapsco River.

If all of these alternatives were implemented on time, the Governor's DMMP, in terms of overall capacity, would satisfy projected placement needs over the 20-year planning window. However, the DMMP has no flexibility to accommodate either the inability to implement any of the options or changing conditions, such as an extraordinary increase in deposition of sediments resulting from episodic storms. There are currently no fall back placement options. Therefore, failure to implement any component of the DMMP would cause significant placement shortfalls relative to placement needs. Furthermore, the implementation of several options is uncertain because the decision-making process is split among various parties and therefore complicated and because virtually all options involve economic and environmental trade-offs. Therefore, the DNPOP program remains active in a continuing search for other alternatives in the event that any of the primary options cannot be implemented. A listing and discussion of the various alternatives is presented in the following sections.

2.2.1. Existing Containment Facilities (less Upland Sites)

2.2.1.1. Hart-Miller Island Dredged Material Containment Facility

The Hart-Miller Island Dredged Material Containment Facility (HMI) is an existing State of Maryland confined placement facility for sediments dredged from Baltimore Harbor and approach channels west of a line between Rock Point and North Point. These sediments by state statute are considered to be contaminated and are required to be placed into a containment facility. The facility also was used as the principle placement site for construction of the 50-foot deep southern approach channels to Baltimore Harbor. The site also received dredged material from maintenance dredging of the Brewerton and Tolchester channels, because no other placement site was available. As a result, the site was prematurely filled to capacity in 1996 even though it was permitted and its capacity was scheduled for use through the year 2000. The residual capacity gained through dewatering and crust management would provide less than a year's placement potential for these channels. The facility was not planned for further expansion of its capacity because of an earlier State commitment to the public not to do so.

As a consequence of the difficulty in implementing alternative placement sites and the imminent prospect of a decrease in channel depths as early as the Winter 1996-1997 dredging season, DNPOP participants recommended increasing the capacity of the HMI North Cell. The State of Maryland proposed increasing the elevation of the North Cell dike system from 28 feet (8.4 m) above mean low water (MLW) to 44 feet (13.2 m) MLW in order to gain up to an additional 30 mcy of capacity through placement and intensive crust management operations. The dike raising received all of the required state and federal permits and is almost complete.

The annual optimal placement capacity of the facility with intensive crust management is 2.5 mcy (1.9 mcm), which is roughly equivalent to the quantity of material currently dredged from Baltimore Harbor and the southern approach channels. Annual placement in excess of 2.5 mcy (1.9 mcm) significantly decreases the capability to dewater and consolidate the dredged materials, thereby reducing the remaining capacity of the containment cell.

The additional North Cell capacity was allocated in the near-term for maintenance dredging for Baltimore Harbor and for the C&D Canal southern approach channels which includes the Brewerton Extension and Tolchester and Swan Point Channel Reaches. Thereafter, the available capacity was programmed for the deepening of Baltimore harbor anchorages. This activity is projected to consume the facility's placement capacity over the next 3 to 5 years. Capacity totaling 7.6 mcy (5.9 mcm) has also been programmed for use in the C&D Canal project. Therefore, HMI capacity will not be available to support dredging of the C&D Canal northern approach channels without overloading the facility, thereby reducing its long-term capacity or adversely impacting other projected work needed to maintain economic viability of the C&D Canal transportation route.

2.2.1.2. CSX/Cox Creek Dredged Material Containment Cells

The CSX and Cox Creek containment cells in northern Anne Arundel County are existing, but inactive, containment cells. These cells were initially constructed on harbor bottom adjacent to the shoreline and used by the Baltimore District, U.S. Army Corps of Engineers (CENAB) for deepening of the Craighill Channel. Currently, the CSX cell is owned by the MPA, having been purchased from the CSX Corporation which also used it for the placement of dredged material. The Cox Creek cell is also owned by the MPA. Both cells are planned for reactivation by the MPA in 1998. The potential annual capacity of the cells with a full-scale crust management program is 0.5 mcy. This capacity has been allocated to maintenance of Baltimore Harbor Channels west of the North Point - Rock Point line and is not available to support dredging of the C&D Canal northern approach channels.

2.2.1.3. New Upper Bay Placement Facility

Although very expensive, construction of an upper Bay placement facility to serve as a large-scale placement facility in the upper Bay is a component of the Governor's DMMP. The length of time involved in performing the necessary environmental and engineering studies and in obtaining approvals and funding is such that this option cannot be implemented for 5 to 7 years, or longer. The earliest target date for commencement of placement following construction of at least one placement cell is the Year 2002. Commencement of placement in the Year 2002 in a new placement facility is dependent upon the following conditions: that there is a suitable location for constructed placement facility; that this option is feasible; that all necessary approvals are obtained; that adequate funding is available for construction; and that no delays are experienced during implementation. The new placement facility will not be available in time to receive dredged materials that must be dredged in the next 5 years.

2.2.2. Upland Sites

2.2.2.1. Sites Along the C&D Canal

There are currently seventeen Federal upland sites designated along the C&D Canal for dredged material placement. These sites are strategically located to accommodate certain channel reaches within the C&D Canal and the northern portion of the approach channels. Periodic expansion of these sites has been necessary to accommodate those channel reach maintenance needs. Major expansions would be necessary to accommodate the southern approach channels. The availability of these sites as placement options would not occur for 4-6 years. Use of these sites for the Grove Point to Tolchester reaches would reduce the long-term potential of these sites for the channel reaches they now serve. This is not an acceptable dredged material management alternative at the present time, because the PCOE has not been able to obtain additional upland sites in these areas, although efforts to find and secure such sites is continuing. Furthermore, the required pumping distances and elevations make use of these sites for reception of materials from the Grove Point to Tolchester reaches uneconomical and inefficient from both fiscal and engineering standpoints (MDOT, 1996; MPA, 1996)

2.2.2.2. Other Upland Sites

The amount of dredged material that would need to be accommodated for the maintenance of the C&D Canal northern approach channels over the next 20 years is estimated at 30 mcy. Over a thousand acres of land on or near the shoreline with riparian access would be necessary to accommodate this quantity of material. Such sites, or even a series of smaller-acreage sites, have not been available despite extensive searches for upland parcels. Recent searches have been conducted as part of the U.S. Army Corps of Engineers study of the C&D Canal and work undertaken by MES and MDNR in conjunction with the DNPOP program. The search for and assessment of upland parcels is continuing in support of the Port's dredged material placement needs.

Implementing any new upland site would be difficult and time consuming. Such sites must consider the defined Chesapeake Bay Critical Area, wetlands, archeological or historical areas, threatened or endangered species, and areas of groundwater recharge. Use of the land would be disrupted for the duration of a parcel's use for placement and for an undetermined period thereafter. The dewatering of sediments and discharge of effluent back to the Bay must also be considered along with long-range plans for subsequent use, if any, of the upland site. Undertaking an upland placement option would also broaden the constituencies whose interests must be considered, further complicating the search for and implementation of acceptable placement alternatives. Although there is hope that additional upland sites can be identified and established, none are anticipated to be available in time to offset the need for expanded capacity in the Pooles Island area.

2.2.3. Beneficial Use

Use of dredged material as a natural and economic resource, referred to as "beneficial use" of dredged material, was advanced as the primary solution for maintenance of channels in Maryland by the 1991 Governor's Task Force. A number of beneficial use proposals were advocated. Most of these have not proven to be implementable. In general, beneficial use projects tend to be quite expensive, and it has been difficult, in most instances, to obtain endorsement of beneficial use options once an option is linked to a specific site. Uses that have been considered include marsh restoration and creation, shoreline stabilization and protection, island restorations, enhancement of fisheries habitat, constructed reefs and various alternative uses such as recycling and use of dredged material as a construction aggregate.

Concerns expressed for in-Bay beneficial use options have been predominantly attributable to environmental tradeoffs related to the conversion of one form of habitat to another, typically the conversion of fisheries habitat. For a project to obtain the support necessary for implementation, the environmental value expected after implementation must be greater than the environmental value of the site prior to the project and must also minimize or avoid impacts to unique habitat. Another drawback to beneficial use projects is the relatively high cost relative to the quantity of material deposited. Such projects often involve small sites, with material placed at an elevation at or near water level (in order to create tidal marshes, etc.), thereby significantly reducing the quantity of material that can be deposited when compared to placement in upland or open-water sites. Use of dredged material for shoreline stabilization or as the foundation for the planting of marshes must be undertaken in relatively protected areas. Typically, expensive physical protection, involving some form of barrier or retention structure, is often necessary to minimize the potential for erosion of sediments. Further, the cost of transportation of material to a site can be considerable. Prospective restoration sites are often far removed from the shipping channels that need to be dredged.

Nevertheless, a large number of beneficial use options have been proposed for the upper Bay. Currently, these options have not gained broad-based interagency or public support. A summary of specific beneficial use alternatives that have been considered follow this section.

2.2.3.1. Sparrows Point Shoreline Improvement and Habitat Creation

A 300-acre habitat creation project was planned for the Sparrows Point area to reclaim industrial shoreline and relatively poor bottom to benefit living resources. The project was to consist of a dike constructed on a geotextile fabric over a very soft and marginally productive bottom area adjacent to the eastern end of Sparrows Point. An engineering study determined the feasibility of constructing a dike system that would be needed to stabilize and protect from physical forces the clean dredged material that was planned for placement. Establishment of a marsh backed by upland habitat was planned as the end use of the project. Nearby residents in Baltimore County have expressed concern regarding additional conversion of Bay bottom in the vicinity of Sparrows Point. Contributing to these concerns is the fact that the area consists of many acres of upland which were created some years ago through the conversion of marshes and Bay bottom through deposition of slag from steel mill operations. There is also uncertainty regarding the applicability of a State statute which prohibits the construction of a containment facility for dredged material within 5 miles of HMI in Baltimore County. Although the Sparrows Point project was intended to advance the beneficial use concept for dredged material management, the project could potentially be considered a containment facility because of the need to construct a dike and lack of specificity in the State statute about what constitutes containment. As a result, the Sparrows Point project has been delayed indefinitely pending more favorable institutional conditions; implementation in the next 4 to 6 years is not anticipated. Even if the site were available, the increased transportation distances would substantially increase the cost of dredging for the C&D Canal northern approach channels. The Sparrows Point project is not a viable alternative for near-term placement of dredged material.

2.2.3.2. Worton Point

A DNPOP interorganization working group identified the potential for a substantial habitat creation project with 8 mcy (6.2 mcm) capacity at Worton Point. Construction of a dike system connected to the shoreline and creation of a combination of upland habitat including perched wetlands as well as intertidal marshes was planned. The project, once constructed, would eliminate or reduce much of the erosion of the point's high cliffs, thereby contributing to local improvement in water quality. Although considerable interorganizational planning had been conducted and a consensus agreement reached on including the option within the program, federal and state resource agencies were reluctant to consider the project because of concerns about potential impacts to fisheries. The area north of Worton Point is within the general spawning reach of important fish species, including striped bass, although the site selected for the project is south of the legally defined spawning area for striped bass. The resource agencies expressed concerns that the bottom area that would be converted by the project is unique and valuable spawning habitat for striped bass. A small recreational fishery is also reported in the vicinity of Worton Point. A deep hole to the northwest of the point is known to have upwelling conditions which anecdotally are reported to carry over into the shallows off the point, thereby creating feeding conditions for striped bass. In response to these concerns, fisheries data for the upper Bay including the Worton Point area was collected and analyzed for PCOE by MES (MES 1997). During the initial effort to collect and analyze fisheries data, the landowner withdrew from participation in the planning process, announced opposition to the project, and denied access to the property needed for geotechnical investigations. The project has been indefinitely delayed and is not a viable alternative for use within the next 6 years.

2.2.3.3. Pooles Island Beneficial Use Options

A DNPOP interorganizational working group identified 5 areas (Carroll Island, Spry Island Shoal, Graces Quarters, Gunpowder Neck and Pooles Island) with 16 individual concepts for creating or restoring intertidal marshes. Some of these sites are within the perimeter of APG. APG, federal and state resource agencies and commercial fisherman expressed concerns regarding the environmental and economic issues related to each of the sites. Except as discussed in Section 2.2.3.4, due to these concerns, active consideration of all sites and configurations has been discontinued, although the concepts remain on file should conditions change.

2.2.3.4. APG Shoreline Stabilization

Given the large amount of shoreline controlled by APG on the western side of the upper Bay, the DNPOP program has maintained a continuing interest in finding opportunities for the placement of dredged material. Encapsulation of UXO using dredged material at two APG sites (J-Field [on Gunpowder Neck] and Graces Quarters) was actively pursued during 1994 and 1995. The Graces Quarters site was examined and screened out based on technical and economic reasons. A small-scale demonstration project combining encapsulation and beneficial use was considered for J-Field, which is a "Superfund" site. The site also has a unique "floating marsh" which is in danger of being lost through shoreline erosion. It was determined that incorporating the project into the facility's installation restoration program (IRP) was potentially feasible. The demonstration project would have had about 1.5 mcy (1.2 mcm) capacity and would have only provided a partial short-term solution for the C&D Canal northern approach channels. During the course of investigating the concept, it was learned that the shoreline and water reaches within the restricted area controlled by APG are contaminated by the presence of between 3 and 30 million rounds of UXO, creating significant concerns for safety. It was also learned that there is no national remediation policy for UXO. There is substantial uncertainty about the degree to which the placement of dredged material would create exposure to liability and technical limitation in locating UXO once buried in sediments. As a result, the proposed J-Field project to encapsulate UXO and to protect an eroding shoreline with a protective marsh has been indefinitely delayed and will not be available to accommodate any of the near-term placement needs for the C&D Canal northern approach channels.

2.2.3.5. Poplar Island

Restoration of Poplar Island is the only beneficial use project under DNPOP considerations that has gained the broad-based interorganizational and public support needed for implementation. The planned placement capacity of this island restoration has been fully allocated to the dredging needs of the southern approach channels to the Port. Use of this site for dredged materials from the C&D Canal northern approach channels would be uneconomical because of transportation costs. For these reasons, Poplar Island is not a viable placement alternative for material dredged from the C&D Canal northern approach channels.

2.2.3.6. Recycling

Recycling of material into construction material and soil supplements, use of sediments for fill and landfill cover, and placement of sediments on farmland have been considered. The recycling concept has not yet been proven to be a viable solution. Dredged material recycling applications in the United States are either in the prototype stage or very small-scale (approximately 0.25 mcy) relative to the Port's dredging needs. Suitably located sites of sufficient acreage to support a large-scale recycling operation have not been identified. There is also no established market for recycled sediments and the market potential has not been determined. The market would have to be developed and would need to consider the economic impacts on the existing market for soils and soil products. Although further investigation of recycling and alternative uses is planned by MPA and MES, the recycling of dredged material in sufficient quantity to reduce the annual demand for other placement options is unlikely for the near future.

2.2.3.7. Reclamation of Mines, Quarries & Sand & Gravel Pits

Reclamation of mines, quarries and sand and gravel pits is a form of recycling dredged material. Although not a new concept, such use of dredged material in the upper Bay region so far has not proven practical. The filling of empty coal cars with dredged material followed by shipment inland for use in reclaiming spent mines and quarries has been considered. Special handling of dredged material during loading or dewatering and consolidation prior to loading would be required, as would double or triple handling of material, additional transportation costs and placement costs at destination. Placement in mines or quarries could potentially require lining or sealing because of the presence of aquifers. Despite these difficulties, the search for such options continues. Several quarries were considered in 1996, but their distance of over 25 miles from the nearest channel and their high elevation makes their use technically impractical and uneconomical for the C&D Canal northern approach channels.

2.2.3.8. Thin Layer Placement in Baltimore's Inner Harbor

Thin-layer placement in Baltimore's Inner Harbor is a concept that is being evaluated by the MDE with support from the MPA and the CENAB. Clean dredged material potentially could be imported from channels outside the harbor and used to cap certain contaminated harbor bottom areas for the purpose of improving water quality. Although ten possible sites have been identified, the potential quantity of dredged material that could be placed appears to be low relative to the overall dredging need. This concept is uneconomical for materials dredged from the C&D Canal northern approach channels, because of transportation costs.

2.2.3.9. Increasing Sediment Trap Potential of Conowingo Dam

Restoring the full potential of the Conowingo Dam pool to trap sediment has been suggested as a way to reduce sedimentation in the upper Bay. In concept, this would be accomplished by dredging the pool behind the dam and transporting the material to suitable upland reception sites, none of which have been identified. The Maryland Geological Survey (MGS) has advised that even if all the sediment from the Susquehanna River were to be eliminated, no appreciable diminution of dredging needs would occur for several decades because of storm-related suspension of sediments already in the upper Bay, erosion of upper Bay shorelines and the subsequent migration of sediments from these sources into the channels.

2.2.3.10. Restoring Bay Bottom Mined for Oyster Shell

Non-living oyster shell beds have been mined through dredging by a private dredging contractor, under a permit held by MDNR, to provide shell needed to seed active oyster bars. The configuration of narrow trenches created by the mining of oyster shell in the upper Bay have a relatively small capacity as placement sites. Additionally, the bottom relief created through shell dredging may have increased the fisheries habitat value of the impacted areas while adversely impacting commercial drift net fishing. Further study of the precision placement of dredged materials, reclamation of additional shell to benefit existing oyster bars, site-specific placement alternatives and bottom restoration techniques would be needed to determine whether or not the concept is feasible. This option has not proceeded past the initial concept stage and would not be available to accommodate near-term placement needs.

2.2.3.11. Use of Geotube Bags to Establish Oyster Bars

Site evaluations at locations where test geotubes filled with dredged material are in use (such as Poplar Island) has shown that geotube fabric is colonized by marine and estuarine growth. However, the option appears to have a small potential capacity for the placement of dredged material and would not be sufficient to accommodate placement needs of the C&D Canal northern approach channels. No specific sites have been identified in the upper Bay where this technique could be applied on a wide scale.

2.2.3.12. Bear Creek Marsh Creation

A small-scale demonstration marsh creation project has been proposed in concept near the mouth of Bear Creek. This option has not proceeded beyond the initial conceptual stage. Its small capacity and transportation distances would make it uneconomical for the placement of materials from the C&D Canal northern approach channels.

2.2.3.13. Eastern Neck Island Marsh Creation and Restoration

Marsh creation and restorations have been suggested for Eastern Neck Island in the Chester River. However, no specific locations on the island have been identified for further consideration. Transportation distances would detract from the economic viability of this option for the C&D Canal northern approach channels. This option does not have a sufficient basis for consideration as an alternative at this time.

2.2.3.14. Swan Point Marsh Creation

Marsh creation has been suggested for Swan Point. Although a preliminary DNPOP technical screening based on anecdotal information was favorable, subsequent preliminary investigation revealed an exposed, eroding shoreline which is routinely subject to high physical energy. These conditions would necessitate the construction of a substantial armored dike system to provide physical protection. The cost of constructing and armoring such a dike as well as transportation costs would detract from the economic viability of this beneficial use option as a placement site for the C&D Canal northern approach channels. Reconsideration of this option as a containment site to provide physical protection for the Rock Hall shoreline has been proposed by local citizens. However, this option has not proceeded past the initial concept stage and strong environmental and social concerns have been raised. This option could not be investigated, and if found suitable, implemented in time to satisfy near-term needs.

2.2.4. Ocean Placement

Ocean placement is technically feasible but too costly because of transportation distances. No ocean sites are permitted for the placement of materials dredged from the approaches to the Port. Furthermore, ocean placement brings with it additional environmental concerns. Ocean placement is not a viable option for near-term placement needs.

2.2.5. Open-Water Sites

The open-water placement of dredged material in close proximity to ship channels has been the primary method of placement and is almost always the least expensive method. Although the open-water placement of clean sediments has proven to be environmentally acceptable in appropriate circumstances, use of open-water placement in Maryland waters has been reduced over the past decade due to concerns expressed by the resource agencies, environmental and public interest groups, and commercial fishermen. Only the eight open-water placement sites in the vicinity of Pooles Island have been available and authorized for use. The following sites have been considered.

2.2.5.1. Worton Point

The Worton Point open-water placement site was examined as part of the "Chesapeake and Delaware Canal-Baltimore Harbor (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement" (PCOE, 1996).

Worton Point is a reconfigured open-water site of approximately 700 acres (2.9 mcm). The aquatic study (Greeley-Polhemus and RMC Environmental, 1994) found the Worton Point area to possess variable substrate (silt/clay and sand) and a high number and high diversity of benthic organisms. As with the Shad Battery Shoal sample area, the area immediately off Worton Point possesses shallow water habitat with large numbers of the bivalves *Macoma balthica* and *Rangia cuneata*. The proposed Worton Point placement area extends south of Worton Point to below Shell Point. The cove immediately south of Worton Point is a deposition area and considerably more shallow as a result of the high energy environment depositing eroded material. Much like the Shad Battery Shoal area, the site possesses much habitat heterogeneity with a small shallow shoal surrounded by greater depths (20-35 feet [6-10.5 m]). It is in close proximity to waterfowl habitat and the site is heavily used by recreational boaters. Anecdotal evidence suggests that the deeper portions northwest of Worton Point are productive fish habitat.

The studies and environmental data collection that would be needed to characterize and assess open-water placement in this area would take about 2 years. The area has also been identified as an alternative for other dredging needs in the Governor's DMMP. Therefore, this option, if feasible, would not be available to accommodate near-term placement needs for the C&D Canal northern approach channels.

2.2.5.2. Shad Battery Shoal

The Shad Battery Shoal open-water placement site was also examined as part of the "Chesapeake and Delaware Canal-Baltimore Harbor (Deepening), Delaware and Maryland Final Feasibility Report and Environmental Impact Statement" (PCOE, 1996).

Shad Battery Shoal is a reconfigured open-water placement site of approximately 760 acres (3.2 mcm). The area is within the state-delineated spawning area for striped bass and is used seasonally as feeding habitat by finfish species common to this region. Shad Battery Shoal is a known concentration area for Canada geese (*Branta canadensis*), scaup (*Aythya* spp.) and Mallard ducks (*Anas platyrhynchos*). Wood duck (*Aix sponsa*)are known to nest nearby. The aquatic study (Greeley-Polhemus and RMC Environmental, 1994) found Shad Battery Shoal to possess variable substrate (silt/clay and sand) and high numbers of two species (polychaete and bivalve) of benthic organisms. The reconfigured portion of the site is moderately deep, and bordered to the west by increasingly shallow depths and to the south by deep water. Bottom placement of material to the south should prevent the migration of hydraulically-placed material and, if necessary, a berm placed east along the basin should eliminate the possibility of material migrating into the channel. Berm construction would result in adverse short-term impacts to the benthic community in the footprint of the berm. It should be noted that in addition to possessing ideal temperature, salinity and current conditions in the spring, the variation in bathymetry which resulted from previous dredged material placement could have played a role in creating the area's desirability as a feeding location for finfish and waterfowl. The bottom relief creates habitat conditions that attract striped bass and other fishes and the shoal is used seasonally for commercial fishing and sportfishing.

The data collection and environmental studies that would be needed to characterize and assess the area for open-water placement would take approximately 2 years. Resource agencies and commercial and sport fishermen have expressed concern about use of the area for placement because of the possible effects on spawning and on the striped bass fishery. Therefore, this option, if feasible, would not be available to accommodate near-term placement needs for the C&D Canal northern approach channels.

2.2.5.3. Pooles Island Sites

The eight existing open-water placement sites in the Pooles Island area have been discussed and analyzed extensively (Figure 1-3). The following descriptions regard the useful placement life under present commitments.

Area D: Filled to capacity.

Area E: Minimal capacity.

Area F: Minimal capacity.

Area G:

Central: Portions of G-Central now form part of the eastern berm of G-West, and are undergoing berm maintenance which began in Fall 1996. No other capacity is available in accordance with agreements with resource agencies to restrict the use of the rest of G-Central due to proximity to potentially valuable fish habitat.

South: Portion of the residual capacity (718,973 cy) used during the 1996/1997 dredging season. Western portion of site is included in site plan for Site 92.

North: Portions of G-North now form part of the eastern berm of G-West, and are undergoing berm maintenance which began in Fall 1996. The site will be filled to capacity.

West: Anticipated to be at or near capacity by Spring 1998.

East: G-East is located to the immediate east of G-North and G-Central. This site was identified as a potential dredged material placement option within the DNPOP during Fall 1995. G-East is a natural shallow depression in the floor of the Chesapeake Bay that has potential capacity of approximately 1.5 mcy (1.2 mcm) of dredged material if filled to elevation -16 feet (-4.8 m) mean low low water (MLLW). Water depths range between -13 and -21 feet (-3.9 and -6.3 m) MLLW throughout the proposed site.

Directly south of the site are known areas of high relief. Concerns have been expressed by resource agencies and commercial and recreational fishermen about the potential migration of placed material into this important fish habitat. Concern has also been expressed by MDNR concerning placement activities in G-East with respect to their oyster shell dredging operation. MDNR has an existing permit issued by the CENAB and a Water Quality Certificate from MDE for recovery of fossilized oyster shell from specified areas of the upper Bay. The site boundaries of G-East overlap with approximately 40% of designated "area D" of the oyster shell dredging permit.

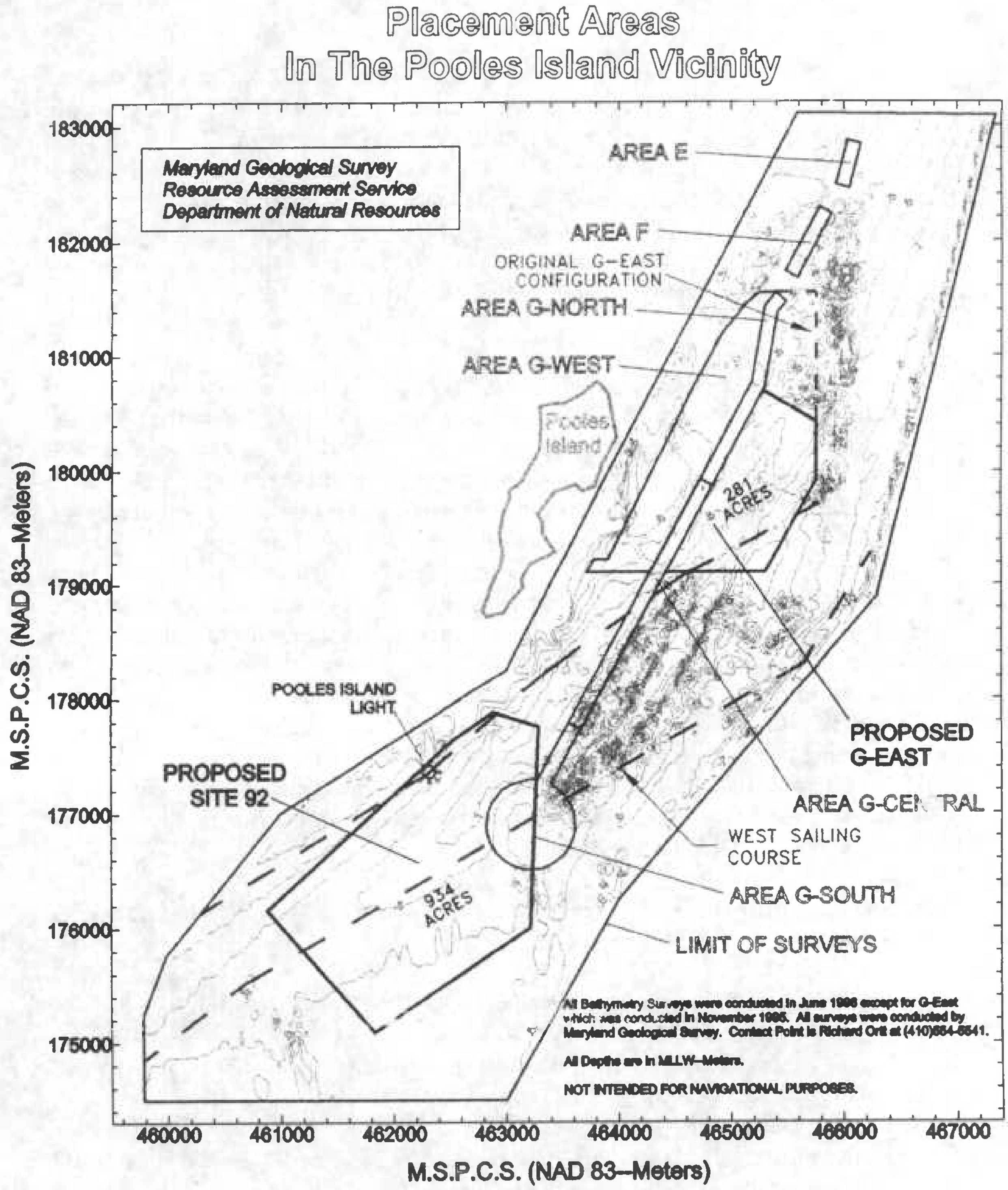
Commercial and recreational fishermen also expressed concern regarding an area of high relief within the northeastern edge of the original site and east of the site as these were considered productive fishing areas. In an effort to characterize the productivity of G-East and Site 92, an angling survey was conducted over the Fall 1996 striped bass season. Results of this study, further discussed in Section 4.5.3.1, indicated that although G-East ranked 3rd in productivity of the 4 sites studied, the area of high relief within the northeastern edge of the original site was a productive striped bass fishing area. Therefore, the original G-East concept area was reconfigured to exclude this area of high relief (Figure 2-1). Exclusion of this area of high relief also largely reduces the overlap with "area D" of the MDNR oyster shell dredging program (Figure 5-11, depicted as area #8). As it does not completely eliminate the overlap with "area D", continued coordination of the oyster shell dredging and placement operations would be required if a Finding of No Significant Impact (FONSI) is issued for use of G-East.

The reconfigured G-East concept is approximately 281 acres (1.1 mcm) and provides approximately 1.2 mcy (0.9 mcm) of capacity. The boundaries of the reconfigured area are as follows:

Beginning at the northeastern-most point at 39 17 22.44N, 076 14 17.27W
Running thence to 39 17 05.30N, 076 14 17.44W,
Running thence to the southeastern-most point at 39 16 39.63N, 076 14 35.28W,
Running thence to the southwestern-most point at 39 16 39.81N, 076 15 11.81W,
Running thence to the northwestern-most point at 39 17 29.49N, 076 14 36.40 and running thence to the point of beginning.

The studies performed to characterize the existing conditions of G-East (presented in Section 4) were performed on the original concept area, hereinafter referred to as the "original G-East" area.

Area H: Possible dispersive site with limited annual placement capacity. Although the site has been used in the past, the deposition of sediments following dispersal is uncertain. Given this fact and the lack of environmental data about dispersal from this site, state and federal resource agencies have expressed concern about use of this and other dispersive open-water placement sites in the Bay.



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ORIGINAL & RECONFIGURED G-EAST

& SITE 92 WITH WEST SAILING COURSE

FIGURE 2-1

2.2.5.4. Site 92

Site 92 is an open-water area located immediately south of Pooles Island that was first considered by MPA's Master Plan initiative in 1986-1988 and was subsequently reconsidered as an option within the DNPOP program. It was added to this assessment initially as an alternative to G-East, in response to concerns expressed by resource agencies, charter boat captains and the Maryland Salt-Water Sport Fishermen's Association (MSSA) about use of G-East for placement (Upper Bay Working Group Meeting Minutes, April 4, 1996). Subsequent studies revealed that use of both sites was estimated to provide the capacity designated in the Governor's DMMP.

The site, as currently configured, consists of part of the northern portion of the West Sailing Course between Buoy R "6" to the south and Buoy G "7" to the north and the western portion of existing placement area G-South. The West Sailing Course is used principally by tugs running without barges and tugs with empty or light-loaded barges. Although the controlling depth of the West Sailing Course is approximately -14 feet (-4.2 m) MLLW, the channel northeast of Buoy R "6" gradually slopes downward to -28 feet (-8.4 m) MLLW creating a relatively flat and smooth depression with virtually no bottom relief. A natural resource screening conducted by State and Federal agencies in support of DNPOP made a preliminary determination that the area was not used extensively by living resources. When concept development and design studies began to reveal that the original configuration of G-East would not support the needed capacity, the concept area for Site 92 was expanded. The site was expanded to tie into existing contours, thus reducing the potential for sediment transport. A berm would be placed within Site 92, along the northeast edge (running north-south), to minimize the potential for material to migrate northeast toward the irregular bathymetry that is considered desirable for fisheries habitat.

The reconfigured Site 92 is approximately 934 acre (3.8 mcm). The boundaries of the reconfigured area are as follows:

> Beginning at the western-most point at 39 15 05.07N, 076 17 40.37W,
> Running thence to 39 15 52.89N, 076 16 30.76W,
> Running thence to the northern-most point at 39 16 00.35N, 076 16 16.10W,
> Running thence to 39 15 56.19N, 076 15 59.30W,
> Running thence to 39 14 59.24N, 076 16 02.88W,
> Running thence to the southern-most point at 39 14 29.95N, 076 17 01.16W,
> and running thence to the point of beginning.

The studies performed to characterize the existing conditions of Site 92 were performed on the reconfigured concept area.

2.3. PREFERRED PLAN OF ACTION

A large number of placement options have been identified and examined for ecological, technical and economic feasibility through the DNPOP program. None of the options that have been identified, except those in the vicinity of Pooles Island, are feasible for meeting short-term placement needs. In addition, existing placement sites are either at or near capacity or are scheduled for use through their projected lives.

The preferred plan of action is to use both reconfigured Site 92 and G-East to fulfill the short-term need for placement areas for sediments dredged from the C&D Canal northern approach channels. Site 92 would be designed to provide approximately 3.7 mcy (2.7 mcm) of placement capacity. G-East would be designed to provide approximately 1.2 mcy (0.9 mcm) of placement capacity.

Initial estimates for the original G-East and Site 92 concept areas indicated potential placement capacities of 8-10 mcy (6.2-7.7 mcm) of material when both sites were brought to -11 feet (-3.3 m) MLLW. However, site design studies, environmental studies, navigational controlling depth requirements and planned placement actions resulted in reduced capacities of the sites.

Three factors reduced the initial 4-5 mcy (3.5 mcm) capacity estimate for Site 92. First, a portion of this site is located within the West Sailing Course, which has controlling depths of -14 feet (-4.2 m) MLLW. Therefore, the portion of Site 92 within the West Sailing Course could not be shallower than -14 feet (-4.2 m) to allow access by the tugs with lightly loaded or empty barges. Second, site design studies, presented in Section 3, indicated potential material transport at elevations above -14 feet (-4.2 m) MLLW. Third, capacity estimates of the site were further reduced when approximately 0.6 mcy (0.5 mcm) of material was placed in permitted area G-South during the 1996/1997 placement season. As is depicted in Figure 1-2, a portion of area G-South overlaps with Site 92.

Two factors reduced the initial 4-5 mcy capacity of the original G-East concept. The site design studies indicated potential material transport at elevations shallower than -16 feet (-4.8 m) MLLW and the concept area was reduced in size as a result of the angling survey.

Use of both prospective placement sites would provide approximately 4.9 mcy of placement capacity. When designed to avoid impacts to adjacent areas and to minimize the potential for erosion and resuspension of sediments, use of only one of the sites would not provide the minimum target of 4.5 mcy of placement capacity specified by the DMMP for expansion of open-water placement in the vicinity of Pooles Island. Therefore, both sites would need to be used to assure the availability of a minimum 4.5 mcy (3.5 mcm) of placement capacity. The additional 0.4 mcy (0.3 mcm) of capacity is desirable in order to provide a contingency for higher than average shoaling rates such as those experienced during 1996 and also to potentially provide an additional year of placement in the event that implementation of other elements of the DMMP are delayed.

Nearby open-water placement sites have been studied and monitored extensively throughout their use. Additional studies in G-East and Site 92 have been conducted to supplement the existing information on the Pooles Island area. Consequently, the understanding of social, economic, cultural, ecological and physical impacts of open-water placement in the Pooles Island area are well established. Dredged material placement in Site 92 and G-East would be planned and designed so as to minimize effects on nearby areas (Section 3).

Site 92 and G-East represent a practical, feasible interim solution to the need for placement capacity and the need to minimize environmental, social, economic and cultural impacts.

3. PROPOSED PLAN OF ACTION FOR G-EAST AND SITE 92

As discussed in Section 2.3, the proposed plan of action is the use of G-East and Site 92 to provide placement capacity for the minimum 4.5 mcy (3.5 mcm) of dredged material that will be generated over the next four years. The use of G-East and Site 92 requires the development of a plan of action for construction of the open-water placement areas that is environmentally sound, technically feasible and provides a minimum of 4.5 mcy (3.5 mcm) of capacity. Development of this plan of action requires knowledge of the existing environmental conditions and potential impacts associated with placement. In addition to performing a literature search and review, a comprehensive data collection effort was undertaken to characterize the existing environment at G-East and Site 92. This effort included the following components:

- Hydrodynamic modeling of existing and plan conditions for G-East and Site 92 by the U.S. Army Corps of Engineers, Waterways Experiment Station;

- Foundation and consolidation studies of G-East, Site 92 and the C&D Canal approach channels by Woodward-Clyde consultants under contract to the PCOE (Woodward-Clyde Consultants, 1996);

- Current velocity, bottom substrate and bathymetric characterizations of G-East and Site 92 by the MGS (Halka *et al.*, 1996);

- Sediment nutrient flux studies of G-East and Site 92 by UMCEES (Boynton *et al.*, 1996a);

- Benthic community assessments in and around G-East and in G-South by MDE (Dalal *et al.*, 1996a; Dalal *et al.*, 1996b). The western portion of G-South is encompassed by Site 92;

- Cultural resource investigations of G-East and Site 92 by Dolan Research and Hunter Research under contract to PCOE (Dolan Research and Hunter Research, 1996);

- Fishing activity studies to characterize the Pooles Island area. These studies included a charter boat angling study performed by MES and UMCEES and review of commercial and recreational fishing activity databases by UMCEES (Miller and McCracken, 1997); and

- Fish abundance, size and species composition studies in the Pooles Island area by SUNY and UMCEES. SUNY performed hydroacoustics and midwater and bottom trawls from 1992 through 1996 as part of the G-West monitoring program (Brandt *et al.*, 1994; Gerken *et al.*, 1995; Weimer *et al.*, 1996; Brandt *et al.*, 1996a;

Brandt *et al.*, 1996b; Brandt *et al.*, 1997). The SUNY studies were conducted in the G-West study area, which included G-East, and in Reference Areas A, B and C. Reference Area A included approximately half of Site 92. UMCEES performed gill net studies in G-East and Site 92 and in the same reference areas utilized by SUNY (Miller and Sadler, 1997).

This section describes the bathymetry of the sites, the placement alternatives considered, foundation, consolidation and data and erosion issues, the placement schedule and capacity, and the proposed monitoring plan. Environmental issues related to the use of G-East and Site 92 for placement are discussed in detail in Sections 4 and 5.

3.1. EXISTING BATHYMETRY

Bathymetry was provided by studies conducted by MGS during November, 1995 and June, 1996 in G-East and Site 92, respectively (Halka *et al.*, 1996). The bathymetric surveys were completed on Site 92 and the original G-East concept areas. The following discussion of G-East has been updated to reflect the reconfiguration of the site.

3.1.1. G-East

G-East lies to the east of G-Central and G-North and west of the C&D Canal northern approach channels (Figure 3-1). Bathymetry within G-East was determined in November, 1995 and integrated with bathymetric data collected beyond the site boundaries in other studies conducted by MGS. Water depths across most of G-East generally range between -15 and -23 feet (-4.5 and -7 m) MLLW, with small areas having shallower or greater depths.

Over most of the northern portion of reconfigured G-East water depths range between -16.5 and -20 feet (-5 and -6 m) MLLW. The southern half of the site is deeper than the northern half; water depths range from -16.5 to -23 feet (-5 to -7 m) MLLW. There is a broad elongated depression, generally oriented northeast to southwest, that extends across this portion of the proposed site. To the south, this basin deepens and extends into waters of -26 to -33 feet (-8 to -10 m) MLLW.

The 16.5-foot (5-m) contour generally follows the entire western boundary of the proposed site and defines the edge of a linear-shaped berm, 8,000 feet (2.4 km) in length. This berm was formed by the placement of scow-released material in G-North and G-Central between 1990 and 1993. Water depths in November, 1996 averaged -15 feet (-4.5 m) MLLW along the top of the berm. The berm received dredged sediments during the winter of 1996/1997 which resulted in both shoaling over the top of, and widening of the base of, the berm.

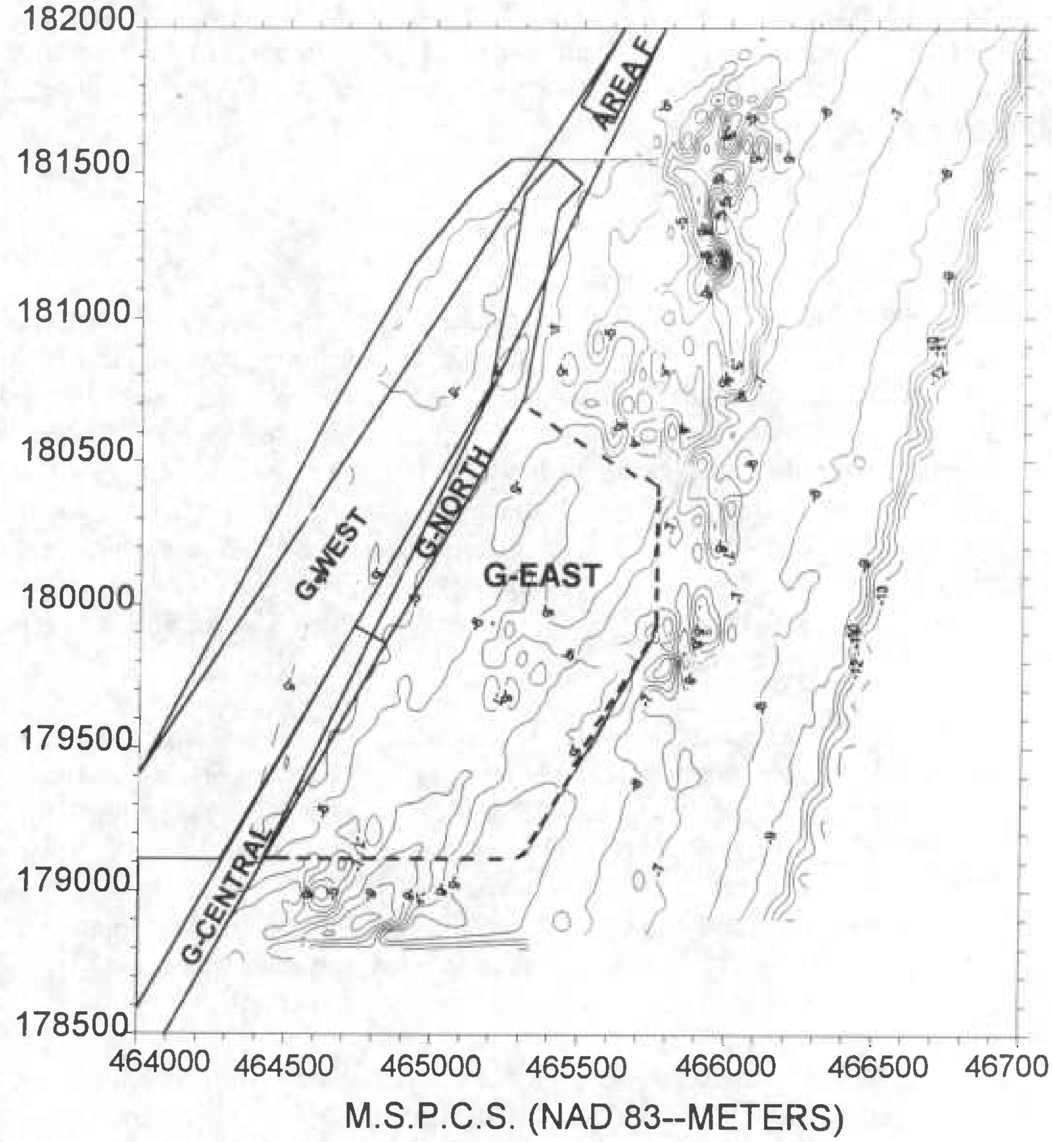


Figure 3-1: Bathymetry of G-East - from November 2, 1995; Reconfigured G-East Shown

Variable bathymetry is located east and northeast of the site, particularly along the northern half. The shallowest depths in this area, defined by the 10-foot (3-m) depth contours, are characterized by concentrations of oyster shell. The deeper sections, where the depths are greater than -20 feet (-6 m) MLLW, represent trenches created from the dredging of this shell by C. J. Langenfelder & Son Company. East of this area of variable depth, as well as east of the southern half of the site, the bottom gradually slopes from -20 to -30 feet (-6 to -9 m) MLLW toward the C&D Canal approach channel.

3.1.2. Site 92

Site 92 lies to the southwest of G-Central and encompasses a portion of G-South (Figure 3-2). In June 1996, the bathymetry in the immediate vicinity of Site 92, as well as in the adjacent area, was determined. Bathymetric data in the surrounding areas had been collected by MGS in other studies conducted in the region, and were integrated with data collected on June 19, 1996 to provide a map of the bottom contours over a larger area. Placement activities in 1996/1997, which placed approximately 718,943 cy (0.6 mcm) of material in G-South, have subsequently changed the bathymetry in the portion of G-South included in Site 92. There is remaining capacity available in G-South, some of which will continue to be included in the Site 92 configuration.

Site 92 surrounds a shallow, elongated basin, oriented in a northeast to southwest direction. Water depths within the proposed site boundary, as shown, range from a minimum of approximately -15 feet (-4.5 m) MLLW along the northwest side of the site to a maximum of about -26 feet (-8 m) MLLW in the north. In the central section of the basin the depth averages around -23 feet (-7 m) MLLW. The basin extends beyond the site boundary both to the northeast and to the southwest where it shoals. In the northeast direction the basin is open to deeper water and variable bottom topography in the vicinity of the panhandle section of G-South.

North and west of the site, the bottom slopes upward to depths less than -11.5 feet (-3.5 m) MLLW. These shallower depths form the southern end of the platform extending southward from Pooles Island. To the south and east of the site, the bathymetry is more planar and depths average -15 to -18 feet (-4.5 to -5.5 m) MLLW. Within the G-South placement area, which overlaps the present boundary of Site 92, an irregularly shaped mound was formed from the placement of scow-released dredged sediment between 1991 and 1993. The water depth over this mound averaged -16.5 feet (-5 m) MLLW in June 1996. This area received additional dredged sediments in the winter of 1996-1997, which resulted in changes in bathymetry from those shown on Figure 3-2. Highly variable bottom topography is located to the northeast of proposed Site 92, and north of the G-South circular area. Water depths within this area vary from -11.5 to -33 feet (-3.5 to -10 m) MLLW over very short distances.

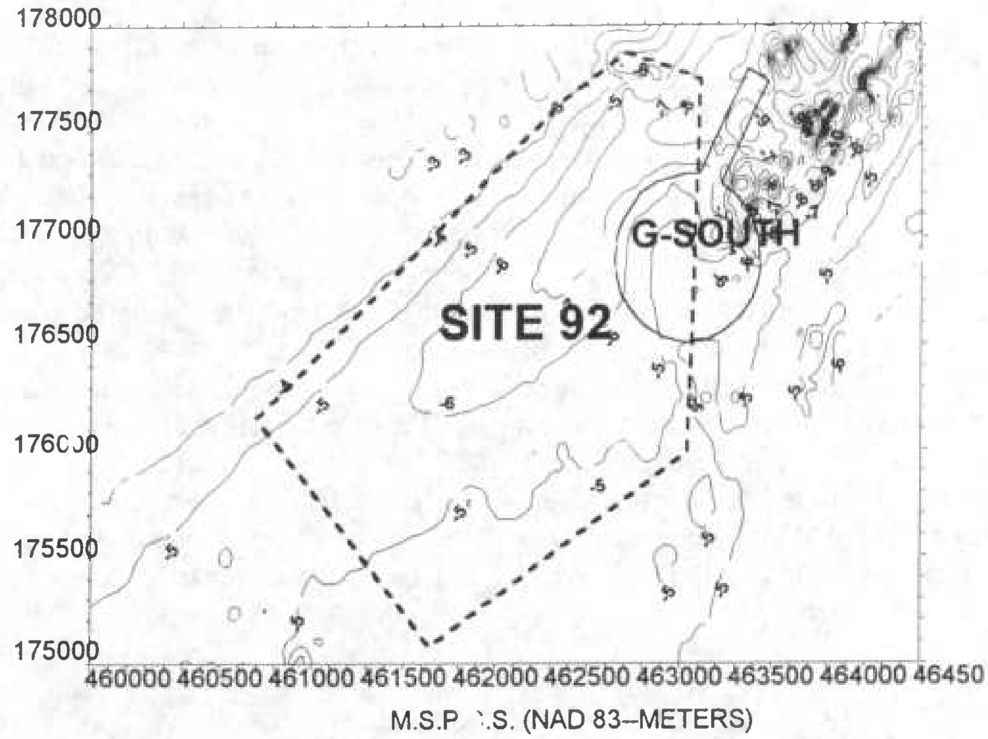


Figure 3-2: Bathymetry of Reconfigured Site 92 - from June 19, 1996; Original Site 92 Contained Completely within Reconfigured Site 92 Boundaries

3.2. ASSESSMENT OF PLACEMENT ALTERNATIVES FOR G-EAST & SITE 92

A series of placement alternatives were evaluated for both proposed placement areas. The alternatives and preferred options are presented below.

3.2.1. Alternative 1: Placement with No Berm

The unrestricted placement of dredged material without constructed berms and bottom release scow placement into the G-East and Site 92 depression areas was analyzed as the first alternative. This option would utilize existing site contours to contain fill material to the extent possible in order to minimize off-site movement of dredged material. Using topographic cross-sections prepared across both G-East and Site 92, placement to a depth of -14 feet (-4.2 m) MLLW in Site 92 and -16 feet MLLW in G-East were evaluated as potential fill elevations. These elevations would minimize lateral movement of dredged material from the proposed placement areas. However, even by limiting fill placement to elevations of -14 feet (-4.2 m) MLLW and -16 feet (-4.8 m) MLLW, fill material could migrate beyond the placement site through low points and downward sloping areas. These low areas could be filled if berms were constructed within the placement sites, along the boundaries, to contain the fill material. Based on interpretation of the bathymetry and identification of areas where material could migrate from the placement sites, placement of dredged material without berms to confine material is not suggested and construction of berms at each site is recommended.

3.2.2. Alternative 2: Placement with Geotextile Tube Berm

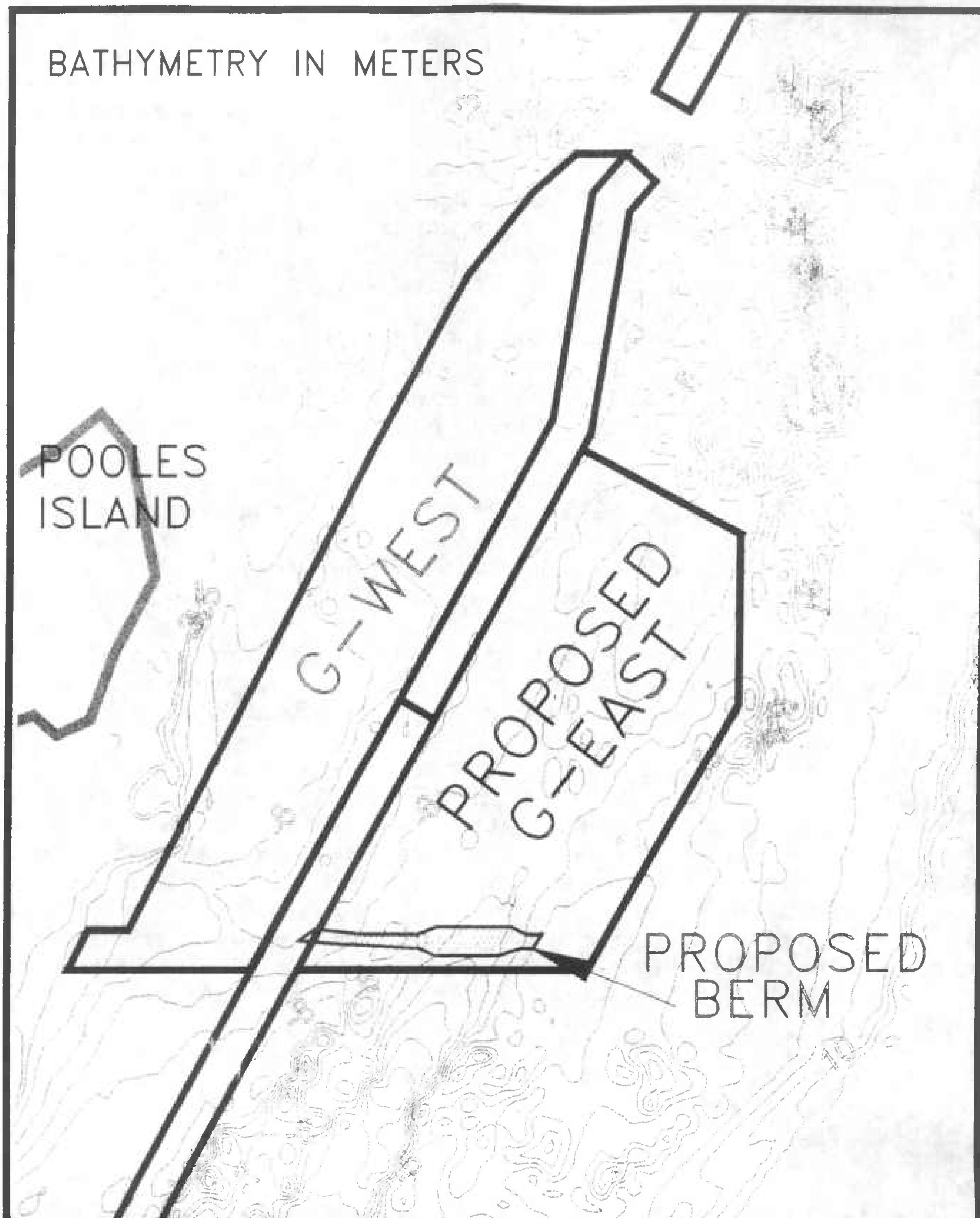
The use of geotextile tubes filled with dredged material was identified as a possible alternative for berm construction. However, this option was not found to be desirable due to the high costs associated with the use of the geotextile tube for berm construction, when compared to other alternatives. The geotextile tube alternative would require approximately 6,000 feet (1,800 m) of filled geotube for construction of the G-East and Site 92 berms.

3.2.3. Alternative 3 - Placement with Dredged Material Berm

Figures 3-3 and 3-4 depict proposed berm locations for G-East and Site 92, respectively. The berms would be constructed of 100% maintenance dredged material placed by bottom release scow, in a similar fashion to the construction of the G-West berm. The G-East berm would be constructed within the site, along the southern edge. The berm elevation would be at -16 feet (-4.9 m) MLLW. The berm would be approximately 2,800 feet (840 m) in length and would require approximately 300,000 cy (2.3 mcm) of dredged material to construct. To prevent fill material from migrating into the productive fisheries area northeast of reconfigured G-East, fill material will be strategically placed by bottom release scow up to the 16-foot (4.9-m) contour adjacent to the area. Fill material will also be strategically placed by bottom release scow further south along the eastern border of the placement area to fill a small trough thereby inhibiting material from migrating off-site. Material placed on the eastern border of the site will be placed to the 16-foot (4.9-m) contour and will be have a 30H:1V slope, with all slopes contained within the site boundaries. After strategic bottom release scow placement as described above, further placement in G-East would be by bottom release scow or hydraulic techniques to -16 feet (-4.9 m) MLLW.

The Site 92 berm would be constructed within the site, along the eastern edge. The elevation of the berm would be -14 feet (-4.2 m) MLLW. The berm would be approximately 3,000 feet (900 m) in length and would require approximately 300,000 cy (2.3 mcm) of dredged material to construct. The berm constructed in Site 92 would have a 30H:1V slope, with all slopes contained within the site boundaries. Placement in Site 92 is restricted to -14 feet (-4.2 m) MLLW by the West Sailing Course and due to potential sediment transport concerns. Bottom release scow placement would occur in Site 92 along the northern edge. After berm construction, further placement in Site 92 would be by bottom release scow or hydraulic techniques to -14 feet (-4.2 m) MLLW.

The berms constructed in G-East and Site 92 would be subject to normal erosive forces typical to the upper Bay. The G-East berm would be subjected to more erosion because it would be positioned perpendicular to the currents (east-west) while the Site 92 berm would be positioned parallel to the currents (north-south). Because of the potential for erosion, controlled bottom placement utilizing scows (similar to techniques utilized for construction of the G-West berms) is the preferred placement technique to construct the G-East and Site 92 berm alternatives. Consolidation and erosion issues related to berm construction are discussed in further detail in Section 3.3.4.



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G-EAST AREA WITH PROPOSED BERM & BATHYMETRY
FIGURE 3-3

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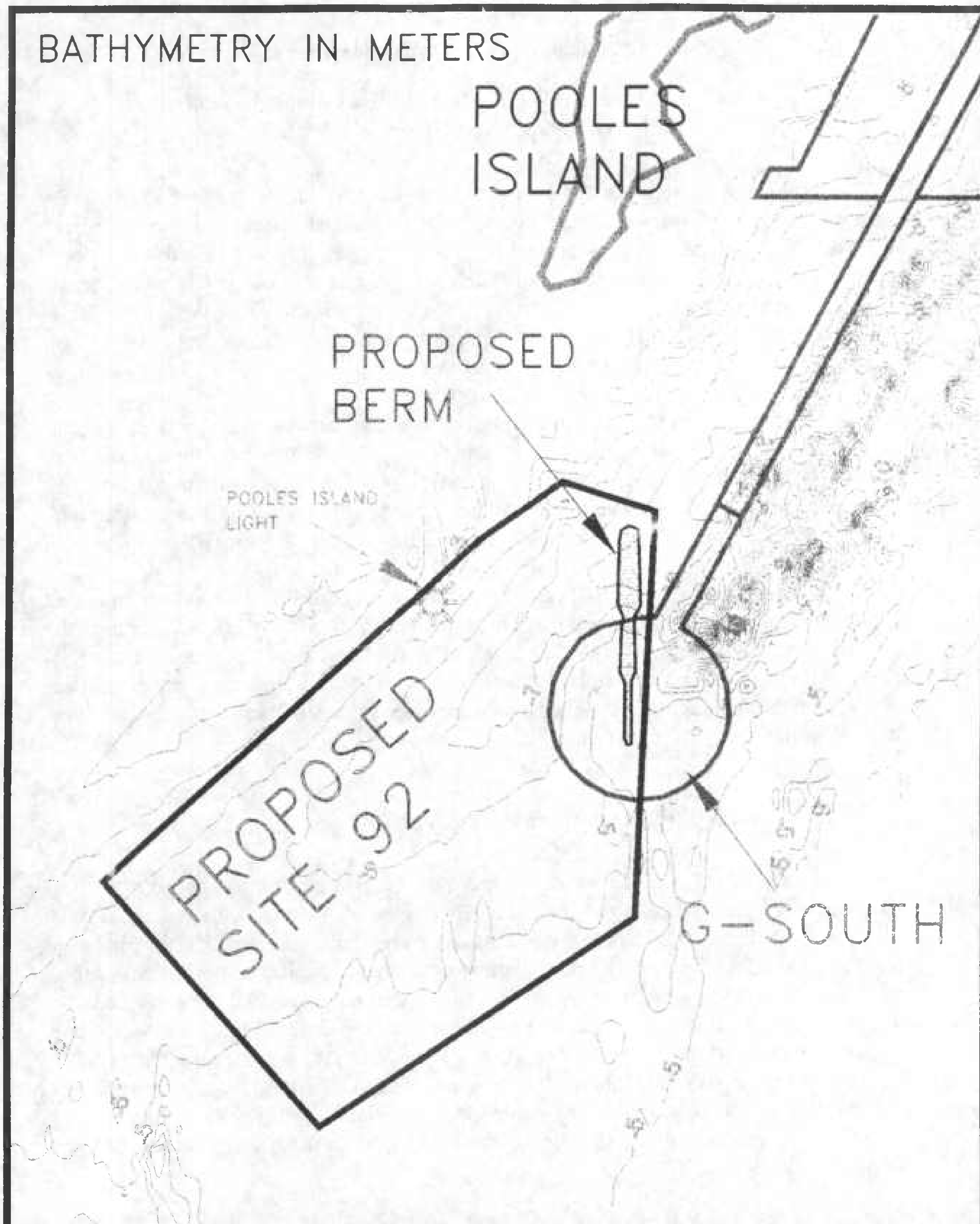

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SITE 92 AREA WITH PROPOSED BERM & BATHYMETRY

FIGURE 3-4

3.2.4. Alternative 4: Placement with a Combination of Dredged Material and Shell or New-Work Material

Figures 3-3 and 3-4 depict proposed berm locations in G-East and Site 92. The berms would be constructed using a mixture of dredged material and shell or new-work material. Use of the mixed material for berm construction would result in a reduced berm width, as this material would achieve steeper slopes. Therefore, berm construction would require less material. Resource agencies have supported the use of the mixed material berms because it would provide suitable substrate for benthic repopulation if something like shell material was utilized.

Mixed material berms would be more resistant to erosion by bottom currents than berms constructed with dredged material alone. In addition to berm construction, to inhibit migration of fill material in specific areas, strategic bottom release scow placement of dredged material would still be required adjacent to the northeastern high relief area and the small trough area as described in Alternative 3 for G-East.

Further discussion with MDNR concerning availability of the shell material indicated that the volume required to create the berms would significantly impact the shell dredging program. PCOE and MPA also investigated use of a mixed material berm utilizing other "new-work" material(s) with better structural integrity than dredged material alone. These investigations revealed that sufficient quantities of new-work material were also unavailable.

3.2.5. Preferred Alternative: Alternative 3

Placement of material with no berm was eliminated due to the potential for sediment migration from both of the sites. Placement of material with geotextile tube berms was eliminated due to the high costs associated with use of the tubes for berm construction. Placement of a berm consisting of dredged material combined with other materials (shell or new-work material) was eliminated as a feasible alternative due to the quantity of material that would be needed and due to economic considerations. The quantity of material necessary for the Oyster Shell Recovery Program would make it difficult to obtain enough shell for use as berm material for the sites. Investigations into the use of new-work material revealed that sufficient quantities were unavailable. Therefore, Alternative 3, use of dredged material to create the berms, is the preferred alternative.

3.3. BERM DESIGN AND CONSTRUCTION

3.3.1. Site Capacity

The stable capacity of each site is that capacity which would not be subject to serious erosion or sediment transport. The stable capacities of the proposed G-East and Site 92 placement areas were determined in order to evaluate the need for the construction of a subaqueous berm to maximize site capacity and contain placed sediments. Without the construction of these berms, erosion and sediment transport would reduce the potential stable capacity of each site. This was determined using various cross-sections developed for each of the placement areas and determining approximate volumes (or stable capacities). The volume for each cross-section was limited to the existing external contours of the proposed placement areas. The approximated volumes are as follows:

G-East	1.2 mcy (0.9 mcm) including 300,000 cy (2.3 mcm) for berm creation, 30H:1V slope
Site 92	3.7 mcy (2.9 mcm) including 300,000 cy (2.3 mcm) for berm creation, 30H:1V slope

In both cases, a berm was used to maximize the capacity of the placement areas by limiting sediment migration. The capacity of Site 92 was based on filling the proposed area up to elevation -14 feet (-4.2 m) MLLW. The capacity of G-East was based on filling the proposed area up to elevation -16 feet (-4.8 m) MLLW.

Evaluation of the cross-sections indicates that in G-East, the Bay floor tended to gradually slope downward towards the southern end of the proposed area. Because of this downward slope from the placement area there exists the potential for placed material to flow out from the placement site. With construction of a berm within the site, which ties into existing higher elevations along the Bay floor, loss of material would be minimized (Figure 3-3). From geotechnical and berm slope information, it was estimated that the potential loss of placed dredged material would be between 130,000 and 325,000 cy (0.1 and 0.3 mcm) due to sediment erosion and transport without the berm.

Evaluation of the cross-sections of Site 92 indicates that a berm should be constructed within the site, in the northeast section (Figure 3-4). The potential loss of placed material would increase by as much as 1.4 mcy (1.1 mcm) due to sediment erosion and transport, without the berm. This is attributed to the depression (down to approximately elevation -24 feet (-7.2 m) MLLW along the boundary of the proposed area. Further south along the boundary, the Bay floor eventually rises to elevation -14 feet (-4.2 m) MLLW, which allows the potential for a berm to be constructed in this area to contain the boundary of the depression and to prevent the loss of fill material.

3.3.2. Berm Design

Regardless of the type of material used in the construction of the berm, it is recommended that the top of the berm be 33 feet (10 m) wide and slope down to tie in with the existing Bay floor. The slope of the berm would be 30H:1V, and would vary with placement conditions.

The proposed berm in G-East is located within the site, in the southern end of the placement area. It has a top elevation of -16 feet (4.8 m) MLLW and is approximately 2,800 feet (840 m) long. The berm runs east-west where it ties into existing 15-foot (4.5-m) contours on the Bay floor. The slopes of the G-East berm vary in length from 148 feet (45 m) to approximately 30 feet (9 m) (Figure 3-3). The entire berm in G-East is located within the boundary of the proposed site.

The proposed berm in Site 92 is located within the site, in the northeast corner. It has a top elevation of -14 feet (-4.2 m) MLLW and runs due south for a length of about 3,000 feet (900 m). The slopes of the berm vary in length from 148 feet (45 m) at the north end of the berm, to approximately 29 feet (8.7 m) at the south end. The slope varies in length as it ties in with the Bay floor because the Bay floor gradually slopes upward from elevation -24 feet (-7.2 m) MLLW to elevation -16 feet (-4.8 m) MLLW. The entire berm in Site 92 is located within the boundary of the proposed site (Figure 3-4).

3.3.3. Foundation

Woodward-Clyde Consultants (1996) conducted geotechnical laboratory testing of soil samples from the upper Bay and the C&D Canal upper approach channel. The laboratory tests performed included water content (ASTM D 2216), Atterberg limits (ASTM D 4318), sieve and hydrometer analysis (ASTM D 422), specific gravity (ASTM D 854), consolidation tests (ASTM D 2435), unconsolidation-undrained (UU) triaxial shear ("Q") tests (ASTM D 2850) and torvane shear tests. These tests were performed on grab and core samples taken on July 3 and 15, 1996.

Based on the results from visual identification and Atterberg Limits (LL, PL), 24 out of 25 samples taken in both Site 92 and the original G-East area were classified as a either a gray, brownish gray or dark gray elastic Silt, classified as MH according to the Unified Soil Classification System (USCS). The other sample, one from each site, was classified as a gray fat Clay (CH). The natural water content for these soils ranged between 77 and 177% (Woodward Clyde Consultants, 1996).

3.3.4. Consolidation and Erosion

One of the primary concerns regarding the construction of the berm is the amount of consolidation settlement which will occur in the subaqueous foundation. Woodward-Clyde (1996) conducted consolidation tests (ASTM D 2435) on six samples, three from Site 92 and three from G-East. Every sample was classified as an elastic Silt (MH) and had the following properties:

Sample	Void Ratio	Unit Weight (pcf)	Specific Gravity	Atterberg Limits	
				LL (%)	PL (%)
92-6	3.828	34.3	2.66	76	40
92-15	3.318	38.5	2.65	76	42
92-17	3.406	38.0	2.67	73	38
GE-5	2.932	41.9	2.64	76	37
GE-19	3.075	40.7	2.66	68	38
GE-23	3.828	34.0	2.63	67	33

The report provided volumetric strain vs. log pressure and compression vs. log time so that parameters such as compression index (Cc) and coefficient of consolidation (cv) could be determined in order to evaluate both the amount and time rate of consolidation.

Assuming a 50-foot (15-m) layer of dark gray elastic Silt (MH) as the foundation material which is doubly drained (aquifer at the bottom of layer and water at the top), average values of the properties of the soil are used to determine the amount of consolidation settlement and the rate of consolidation for a 6-foot (1.8-m) high embankment with a 33-foot (10-m) top width and 30H:1V side slopes and a unit weight equivalent to that of the foundation.

The settlement of the berm is computed by assuming that the construction period is much less than the time of settlement (i.e., the berm is constructed instantaneously rather than over a period of time), and the foundation soil is normally consolidated. The latter is based on assuming that the soil is not newly deposited.

An embankment with the aforementioned dimensions and unit weight of 40 pcf will exert an increase of vertical stress of approximately 220 psf at 25 feet below the base of the berm. The effective initial overburden stress at 25 feet ((7.5 m) below the berm is 608 psf. Therefore, a normally consolidated 50-foot (15-m) layer subjected to the above calculated stress, the estimated settlement is 0.667 to 1 foot (8 to 12 inches; 0.2 to 0.3 m) or approximately 12% of the berm height. The relatively low amount of settlement is attributed to the low surcharge which is applied by the berm.

While the amount and time rate of settlement appears to be very low, the possibility of the displacement of the foundation material due to the placement of the dredged material used to form the berm must be considered. Because the surcharge of the berm is relatively low, due to the hydrostatic stress of water, the berm itself would most likely not undergo substantial elastic settlement. However, this would depend on the material used to construct the berm and the method used for placement. Post-placement data compiled by MGS of sediments from the approach channel to the C&D Canal placed hydraulically and by hopper dredge from 1990-1993 indicate fractional volumetric reduction attributable to deposited sediment consolidation to be 25 to 40% (Panageotou and Halka, 1995). The amount of self-weight consolidation of sediments placed by bottom release scow placement methods is expected to be less. Data from G-South indicate a 14% volumetric reduction attributable to self weight consolidation in the twenty months following bottom release scow placement during the 1989-1990 winter (Halka, 1993).

The berm also would be subjected to erosion due to water currents and the natural tendency of berm sediments to displace and stabilize. Post-placement data compiled by MGS of sediments from the approach channel to the C&D Canal hydraulically and by hopper dredge from 1990 to 1993 indicate the fractional volume reduction attributable to erosion may be 10 to 25% (Panageotou and Halka, 1995). Once again, the volumetric reduction will depend on the material selected for the berm and the type of placement used. The potential for erosion of the berm can be expected to decrease over time as the surface tends to armor with the removal of fine grained sediments.

Overall, the height of the berms constructed at the Site 92 and G-East placement areas may be reduced from 20 to 30% volumetrically due to a combination of foundation consolidation, berm sediment consolidation and erosion of sediments from the surface of the berm deposit. This consolidation and erosion calculation is based on the aforementioned study for G-West and that current velocities at Site 92 and G-East are similar to and have the same potential for sediment resuspension as placement sites in the Pooles Island vicinity (Halka *et al.*, 1996).

3.4. PLACEMENT SCHEDULE AND CAPACITY

The berms for G-East and Site 92 would be constructed prior to placement of dredged material in either site. Site 92 would be the first area utilized for dredged material placement and the area would be filled to capacity, up to the -14-foot (-4.2-m) MLLW contour interval. Once Site 92 had been utilized, G-East would then be filled to capacity, up to the -16-foot (-4.8 m) MLLW contour interval. Berm construction at both sites would require the placement of approximately 300,000 cy (0.2 mcm) of maintenance dredged material. In addition to berm construction at G-East, bottom release scow placement techniques would be utilized in two areas within the site, one along the northern edge and one along the eastern edge of the site, to prevent migration of material from the area. In Site 92, the use of bottom release scow placement techniques within the site, along the northern edge, will be investigated during the design and construction phase.

The placement techniques to be utilized at G-East and Site 92 are currently being investigated and will be determined at a later date. Fill placement may occur by hydraulic or bottom release scow methods at both sites. Placement in Site 92 would occur over consecutive placement seasons. Depending on the annual need, it is probable that one annual placement action would be required to fill G-East.

The total estimated capacity of Site 92 when filled to -14 feet (-4.2 m) MLLW is approximately 3.7 mcy (2.9 mcm. The total estimated capacity of G-East when filled to -16 feet (-4.8 m) MLLW is approximately 1.2 mcy (1.1 mcm). Needs for capacity vary annually, so the actual volumes placed at G-East and Site 92 would vary according to the annual need. Site 92 would have a useful life of 2 to 3 years and G-East would have a useful life of approximately 1 year, based upon the estimated annual need of 1.5 mcy per year (1.2 mcm/yr). Capacity estimates are based on bathymetry surveys and consolidation studies. Actual capacity will be determined through placement monitoring and will be revised accordingly.

3.5. MONITORING

Baseline conditions and placement impacts have undergone intense study in G-West. Baseline conditions and projected impacts of the proposed action are discussed in Sections 4 and 5 of this document.

A monitoring program that studies and evaluates a project both during activities and upon completion of phases is an integral part of this project. The proposed monitoring program will be the product of an integrated effort to meet regulatory requirements as well as meet goals and objectives of existing Bay-wide programs and projects. The specific needs of resource agencies have been discussed and examined. The monitoring program will be submitted for approval to MDE as part of the Water Quality Certificate requirements for this project.

Because G-East and Site 92 are within the Pooles Island area, the components of the monitoring program will reflect and be integrated with existing databases and projects that are both complete and on-going, including the G-West comprehensive monitoring program. The primary components of the monitoring program for G-East and Site 92 will include:

Site Management

Review of pre-placement surveys to verify site capacities and locations of dredged material in the berms

Review of during-placement surveys to monitor volumes placed, placement duration and locations of placed material

Review of post-placement surveys to estimate available capacities

Production of an annual monitoring report documenting placement activities, volumes and locations placed

Capacity, Consolidation and Erosion

Pre-placement studies - foundation consolidation studies and hydrographic surveys

Consolidation surveys - pre-placement, post-placement and 1,3,6 and 9 month surveys after completion of placement

Sediment resuspension and erosion testing and calculation after placement studies

Annual report on consolidation and erosion rates, available capacities, site conditions

Water Quality, Benthic Community Repopulation

Compliance monitoring at the direction of the Maryland Department of the Environment, as per the Water Quality Certificate

Effects of dredged material placement at the Pooles Island site have been documented since 1964. Dredged material placement in designated areas has been accompanied by various types of baseline (pre-), during and post-placement monitoring studies since that time. Pertinent information from these studies is included in Sections 4 and 5 and the sources are listed in the References section of this document. Most of the monitoring prior to 1990-1991 was concerned with four aspects and had a limited, focused scope of study on dredged material placement. The four aspects studied prior to 1990/1991 included: water quality related to turbidity; ecological effects, primarily to striped bass and benthic organisms; capacity; and placement and consolidation measurements.

In 1991, Maryland resource agencies requested that a comprehensive monitoring plan be developed as part of the dredged material management efforts. The primary goal of these efforts was to gain a greater understanding of the environmental effects of dredged material placement. A study was designed in 1991 to gather and analyze data on baseline (pre-), during and post-placement conditions of existing sites in use near Pooles Island. The study focused on capacity of the placement sites, sediment chemistry, sediment toxicity, nutrient loadings, sediment transport, sediment-water interchanges, benthic invertebrates and fish characterization. These study parameters represented a thorough inventory of the topics of greatest interest to the resource agencies. The individual studies were designed with a goal of rectifying "data gaps" in the available literature on Pooles Island placement. A comprehensive monitoring plan was also implemented by the Corps of Engineers, Philadelphia District and the Maryland Port Administration for placement activities at G-West and is ongoing. The purpose of this monitoring is to verify the projected findings of the EA for G-West, which predicted near-field short term impacts from placement. Some monitoring elements have been reduced as the findings have matched the projections of limited impacts over several years of data collection and study.

To date monitoring of G-West and nearby placement actions has included :

- Turbidity monitoring was conducted for one year of placement activities at G-West which verified the short-term duration of turbidity plumes previously documented during monitoring of other placement actions (Panageotou and Halka, 1990; Halka *et al.*, 1994a; Halka *et al.*, 1994b; Panageotou and Halka, 1995);

- Sediment nutrient flux monitoring of reference areas and placed sediments for three years at G-West (Boynton *et al.*, 1994; Boynton *et al.*, 1995; Boynton *et al.*, 1996c), added to one year of monitoring performed at Area G-Central (Boynton *et al.*, 1993);

- Fisheries abundance, size and species composition monitoring for four years at G-West by Brandt *et al.*, 1994; Gerken *et al.*, 1995; Weimer *et al.*, 1996; Brandt *et al.*, 1996a; Brandt *et al.*, 1996b; Brandt *et al.*, 1997). This is added to one year of fisheries data collection at Area G-South (Jesien *et al.*,1994);

- Annual data collection on consolidation and resuspension of the placed sediments by the Maryland Geologic l Survey (Halka *et al.*, 1995; Panageotou *et al.*, 1990; Panageotou *et al.*, 1993; Panageotou *et al.*, 1995; Panageotou *et al.*, 1996);

- Annual water quality data collection by the Maryland Department of the Environment (Michael *et al.*, 1991, Romano *et al.*, 1995; Dalal, 1996c);

- Pre-placement benthic condition studies and post placement evaluations of benthic community recovery (Versar, 1992; Versar, 1993; Versar, 1994; Ranasinghe and Weisberg, 1995; Dalal, 1996b); and

- Fishing activity data collection and reports (MDNR, 1994; MES, 1995; MES 1997b).

Findings from all of the above monitoring activities have continued to verify the short term negative impacts predicted in the G-West Environmental Assessment.

The proposed monitoring plan for this project will be supplemented with the monitoring efforts conducted specifically for this evaluation of sites G-East and Site 92. Scopes of work and specifications will be drafted to address basic regulatory requirements as well as to integrate data collection and analysis with the G-West comprehensive monitoring and other related Bay programs.

If unanticipated or negative impacts from placement occur, the monitoring programs will be in place to detect them and alterations in placement techniques or other actions can be taken to control any adverse impacts. The alterations can then also be monitored to ensure that the predicted conditions occur.

Data collection activities for other open-water sites in the Pooles Island area offer additional opportunity for study integration as well as provide an existing database for the prediction of impacts from the proposed placement actions, presented in Section 5 of this document.

4. EXISTING ENVIRONMENT

4.1. HYDRODYNAMICS

Hydrodynamics is defined as the branch of physics having to do with the motion and action of water (Webster's, 1982). In estuaries, such as the Chesapeake Bay, the water mass movement is governed by a variety of time-dependent processes that act on different time-scales. The twice daily rise and fall of the tide is the most obvious dynamic in the Bay. Information on velocity and timing of tidally induced currents can be derived from tidal activity data. Currents other than those tidally driven also produce hydrodynamic variations that are of a more seasonal nature. Fresh water discharges from rivers create density-driven currents and volume-induced currents. Wind effects and gravitational circulation also affect the hydrodynamic characteristics of the estuary. Studies by Sanford (1994) have shown that wave-induced effects on bottom sediments (wave forcing) could be expected to impact the entire Chesapeake Bay and have more of an effect than tidally-induced resuspension.

Most of the Chesapeake Bay is described as being microtidal, indicating a relatively small range of tide (Homer and Mihursky, 1992). Tidal force enters the Bay through the mouth, and travels northward up the Bay, dissipating with distance as it is damped by bottom friction. This damping action is significant due to the Bay's length and shallowness, and, coupled with the great size of the Bay compared with the entrance dimensions, creates a tidal range in the mainstem of between 1 and 3 feet (0.3 - 0.9 m). G-East and Site 92 experience an average tidal range of 1.3 feet (0.4 m) (Browne and Fisher, 1988). The mean tide period (high to high or low to low) averages 12.42 hours (12 hours 25 minutes).

The tide in this portion of the Bay is further classified as mixed, mainly semi-diurnal. That is, there are nearly two full tide cycles per day but with unequal levels in successive highs or lows. This asymmetry also causes currents to have unequal maxima.

A second tidal component enters the Bay through the C&D Canal (Browne and Fisher, 1988). However, due to the small cross-sectional area of the C&D Canal, this constituent has little effect on the tidal range in the upper Bay relative to the oceanic tide entering at the mouth of the Bay.

The primary component modifying the movement of tides in the upper Bay is fresh water discharges from the rivers that flow into the Bay. The Susquehanna River supplied more than 50%, on average, of the freshwater input to the entire estuary, and over 64% to the Maryland portion over the period of 1980 to 1991 (Magnien *et al.*, 1993). In the portion of the Bay north of Baltimore (which includes the study area), the Susquehanna River supplies in excess of 90% of the fresh water.

Addition of fresh water modifies tidal action and the associated currents. The fresh water, which is less dense than the saline water that enters from the south, tends to overlie the latter and flow seaward along the surface. The denser seawater balances the water mass of the estuary by flowing up-estuary. This type of circulation, termed "gravitational circulation" typically exhibits velocities on the order of 0.07 - 0.16 ft/sec (5-20 cm/s) (Sanford, 1993). This process enhances ebb flow in surface water layers and flood flow in bottom layers.

The estuarine circulation is relatively constant over a tidal cycle, but it changes over longer time scales in response to changes in fresh water discharge from the Susquehanna River. Average flow of the Susquehanna River varies throughout the year in response to seasonal changes in rainfall, evapotranspiration, and temperature. The highest flows are generally recorded in the winter and early spring and the lowest in the summer and early fall. Over the eight year period from 1984 to 1991, average monthly flow in the period from February through April was in the range of 40,000 to 75,000 cubic feet per second (cfs). Average monthly summer low flows in the June through September period were below 20,000 cfs (Magnien *et al.*, 1993). A moderate increase in flow from the Susquehanna River can serve to decrease the salinity of the surface water in the Chesapeake. This results in an increased density difference with the underlying saltier water, and enhances the salinity stratification. There is a corresponding increase in the ebb flows of surface waters and increased flood flow in denser bottom waters. A substantial increase in fresh water flow can push the saltier, oceanic derived water from the upper portions of the estuary and result in the entire water column in the study area being fresh. This portion of the estuary then takes on the flow characteristics of a river. Although the tides may rise and fall moderately, the tidal effect is damped and water tends to flow seaward at all depths at all times. This is a common occurrence during the spring freshet in the vicinity of G-East and Site 92. Variations in fresh water flow from the Susquehanna River can thus act to alter both the speed and direction of water movement at different elevations in the water column throughout the year.

The last factors influencing the movement of water in the estuary is the action of wind and waves. Sanford (1994) has shown that wind and wave forcing are the major influences on sediment resuspension in the Chesapeake Bay because the Bay has “a fairly low-energy tidal environment.” Wind forcing produces surface waves, whose size is dependent not only on the speed of the wind but also on the depth of the water, the length of time the wind has been blowing (duration), and the distance over water (fetch). Surface winds induce a near surface current flowing in the direction of the wind and surface waves produced by these winds create oscillatory currents in the water column. In the Chesapeake Bay, this wave forcing results in significant bottom sediment resuspension (Sanford, 1994). Stratification of the water column can be strongly influenced by waves resulting from wind action. Due to the oscillatory water motion and the directional currents produced by winds, a strong wind event can mix the fresh surface waters with denser saltier waters underneath. This acts to reduce the density stratification that is often present in the water column. Throughout much of the Bay this occurs in the fall as surface water temperatures decline and storm events occur. In the study area, where there is little to no stratification, even moderate wind events in the late spring and summer mix the entire water column (Austin *et al.*, 1991). Variations in the strength and duration of wind events can affect the currents in the Bay, especially in the study area, in a variety of ways depending on the interplay of the wind induced currents with the underlying tidal current action, the amount of fluvial input to the system, and the degree of vertical stratification and induced gravitational flow.

Estuarine circulation is relatively constant over a tidal cycle, but it changes over periods of weeks to months in response to changes in fresh water runoff and mixing and can change daily in response to wind and storm events. These effects are more pronounced in the upper Bay due to the shallowness of the water, the narrow width of the estuary, and the large percentage of fresh water input from tributaries.

4.1.1. Salinity

Salinity in the upper Bay varies with freshwater influences. However, the hydrology of the Bay is characterized by surface waters being directed down toward the mouth of the Bay and bottom waters moving up from the ocean. Fluctuations in seasonal salinity readings also reflect fresh water and river contributions. Surface and bottom water salinity data for the period of 1987-1995 from the Chesapeake Bay Monitoring Program (CBMP), Chesapeake Bay Mainstem water quality monitoring station MCB3.1 is presented in Figure 4-1. Station MCB3.1 is located in the upper Bay, east of the channel off of Fairlee Creek. The range of salinity includes both the oligohaline and low mesohaline regimes, with oligohaline being the predominant condition between February and July. Salinity is a vital factor in the viability of many species of fish eggs and larvae. Additionally, some adult aquatic species exhibit preferences for specific salinity ranges and will migrate with the seasonal fluctuations in the salt-water wedge. Adults of other species rely on ecological cues and conditions such as salinity.

The changing flow of the Susquehanna has a direct influence on the salinity. High flow years such as 1991, 1993, 1994 and 1996 result in low salinities while low flow years such as 1992 and 1995 result in increased salinities in the upper Bay area (Boynton *et al.*, 1996a).

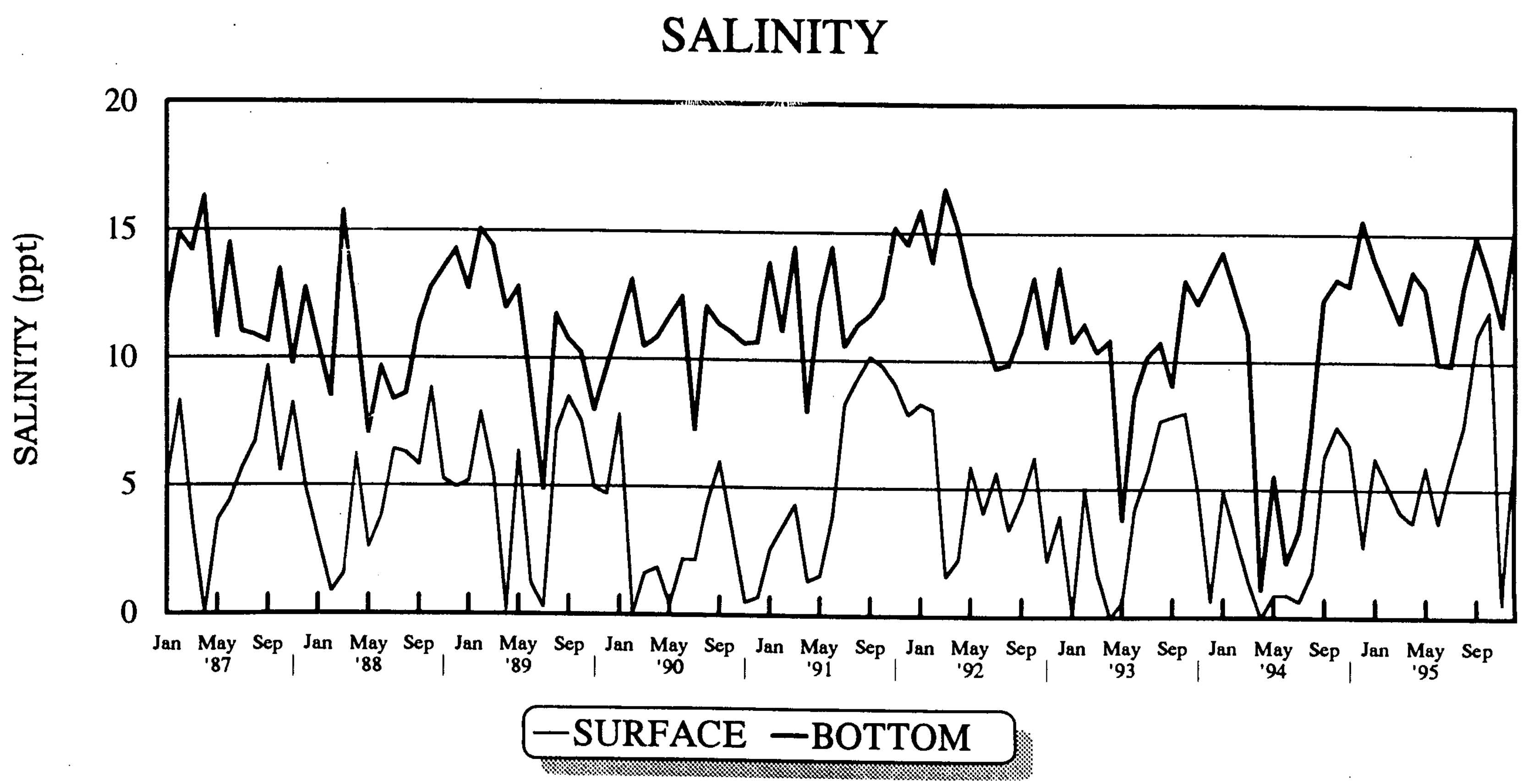


Figure 4-1: Water Quality Data For Pooles Island Area From Water Quality Monitoring Station MCB3.1

4.1.2. Erosive Forces

Fine-grained sediments such as those dredged from the C&D Canal approach channels are potentially eroded and transported by currents in the overlying water column. These sediments are termed cohesive. While it is generally understood that the erosion rate is determined by a balance between the fluid shear stress applied to the sediment bed and the bed shear strength; the factors that determine these two quantities are numerous, spatially heterogeneous, and temporally variable. The factors which influence the sediment erosion potential include interparticle forces, biogenic adhesion and bioturbation, physical and mineralogical composition, organic content, and the time histories of resuspension and deposition (Dyer, 1989; Sanford *et al.*, 1991; Sanford, 1994). The fluid shear stress is generated by the movement of the overlying water and at any particular location it is determined not only by the factors influencing the motion of the water, as discussed above, but also by the local bathymetry, water depth, and bottom roughness (Grant and Madsen, 1986; Wright, 1989). The potential for erosion and movement of sediments under similar conditions has been studied by MGS and Sanford.

MGS conducted data collection cruises in the G-East and Site 92 placement areas. Acoustic sub-bottom profile data were collected on June 24, 1996 at both sites. The data showed that in G-East and Site 92 the bottom substrate had some to abundant shells present. The shell was all relic material with no live specimens recovered (Halka *et al.*, 1996).

Bathymetric data, collected on November 2, 1995 (G-East) and June 19, 1996 (Site 92), are presented in Section 3.1 and Figures 3.1 and 3.2. In addition to bathymetric data, bottom substrate data were also collected on July 12, 1996 in both areas. The bottom substrate in G-East was characterized as clayey silt (2.8 to 16.3% sand, 50.2 to 69.8% silt and 17.6 to 43.2% clay). The bottom substrate in Site 92 was also characterized as clayey silt (1.5 to 5.3% sand, 51.2 to 59.2% silt and 36.9 to 46.9% clay). The water content of the bottom substrate in G-East ranged from 46 to 58%, while bulk density ranged from 1.38 to 1.52 g/cc. The water content in Site 92 was 51 to 63%, while bulk density ranged from 1.31 to 1.45 g/cc (Halka *et al.*, 1996).

The MGS measured current velocities throughout the water column of G-East and Site 92 on August 28 and 29, 1996. At G-East, maximum velocity during flood tide exceeded 35 cm/sec and maximum velocity during ebb tide exceeded 40 cm/sec. At Site 92, maximum velocity during flood tide exceeded 45 cm/sec and maximum velocity during ebb tide exceeded 55 cm/sec (Halka *et al.*, 1996).

The tidal current velocity data was utilized to calculate the potential bottom shear stress and determine the potential for dredged material to experience erosion greater than that observed and/or calculated at other open-water placement sites in the Pooles Island area. The bottom shear stress at the time of maximum current velocities in G-East was 1.64 dynes/cm^2 at flood tide and 2.22 dynes/cm^2 at ebb tide. In Site 92 the measurements were

2.78 dynes/cm^2 at flood tide and 1.99 dynes/cm^2 at ebb tide. The bottom shear stress calculations revealed that G-East and Site 92 are likely to have the same potential for deposited sediment resuspension as previously designated placement sites in the Pooles Island area (Halka *et al.*, 1996).

Sanford (1994) studied bottom sediment resuspension in placement areas D and E located near Pooles Island in 1990 and 1991. This study focused on the effects of wave forcing on bottom sediment resuspension and erosion of the placed material. The study was conducted on one area where sediments had been consolidating for a year and another area where sediments had been consolidating for less than one month. Sanford found that low-frequency currents dominated the semidiurnal tide and that these currents reversed between 210 and 220 degrees true north during ebb and 30 and 40 degrees true north during flood tides. Sanford also found that the ratio of average depth to average width for the entire Chesapeake Bay was only slightly smaller than that of the upper Bay; therefore, wave forced resuspension would be expected to play as important a role in the lower and mid-Bay as it does in the upper Bay

Sanford's study revealed that the estimated erosion from wave forcing on the placed sediments was only 2 millimeters. The study also revealed that the material that had been consolidating for a year was less influenced by wave forcing than the material placed less than one month prior to the study. Sanford concluded that the wave forced erosion was a short-term factor on sediment resuspension.

4.2. PHYSICAL AND CHEMICAL ENVIRONMENT

4.2.1. Geology and Sediments

The Chesapeake Bay Estuary was created by flooding of the Susquehanna and rising sea level associated with the melting of glaciers which began approximately 18,000 years ago (White, 1989). The former Susquehanna River valley, which was carved from weakly consolidated sediments of Cretaceous, Tertiary and Quaternary origin (Kerhin *et al.*, 1988), was slowly inundated by the sea, and the Chesapeake Bay began to take shape. The present appearance of the Bay is only a few thousand years old; in geologic terms, its shape is brief and ephemeral. The sedimentary processes that are currently witnessed are dynamic and have a profound effect on the nature of the Chesapeake Bay Estuary. The geological state of the Bay is constantly in flux. The erosion of its shoreline is partially counteracted by the input of sediments from its many tributaries. Some areas are eroding rapidly while others are filling in, like the colonial port of Joppatowne, which is now located approximately two miles from navigable water (White, 1989).

In 1996, the Susquehanna River flow was an average of 84,240 cubic feet per second (cfs). This flow rate and volume was much higher than in 1995, which was a notable low flow year, and more constant than in 1993 and 1994, which were characterized by spiked flows (Boynton *et al.*, 1996a). With such massive volumes of water, large amounts of sediment are carried and deposited into the Bay; it is estimated that approximately 1.266 million metric tons of sediment are discharged into the upper Bay from the Susquehanna River annually (Panageotou *et al.*, 1996). The Pooles Island area of the upper Bay lies in the turbidity maximum zone of the Chesapeake Bay Estuary.

The "turbidity maximum" is an area of constant mixing and resuspension of sediments. In the riverine portions of the Chesapeake Bay Estuary water flow is seaward and sediments are carried to the mainstem of the Bay. As the estuary broadens the flow slows and sediments begin to settle out of the water column. The coarser sediments settle out first while the finer particles remain in suspension the longest. Further seaward in the tidally influenced portion of the Bay typical estuarine circulation patterns occur. Water flows towards the sea in the upper fresh water layers while denser saline water from the sea moves up the Bay. Fine sediments in the upper layer settle into the saltier bottom layer and are carried back up-estuary. At the head of the "salt water wedge", created by the interphase of these two layers, some of the fine sediment is reinjected to the upper layer and returns seaward, thus remaining suspended. The location of the salt water wedge is dependent on fresh water inflow from the Bay's tributaries, mainly the Susquehanna River (Schubel, 1968a; Schubel, 1968b; MES, 1993).

Because of the turbidity maximum and the particle size of the sediments, the levels of suspended sediments in the upper Bay are relatively high. The sediment grain size in the upper Bay, from the Sassafras River to Tolchester, is generally that of clayey silt with relatively little sand (Halka *et al.*, 1991). There is a constant state of sediment deposition and erosion. The C&D Canal approach channels are continually being filled in with fine sediments. The subsequent dredging of these channels necessitates finding areas for dredged material placement. There are a number of historically used open-water placement areas east of Pooles Island.

The sediments of an estuary have profound effects on its ecology. Sediments act as storage and under certain conditions, release nutrients, and hence are potential sources of nutrients and other possible contaminants; sediments are also sites for the consumption of organic matter and oxygen. Processes such as these effect water quality and habitat conditions (Boynton *et al.*, 1996a). The majority of suspended sediment that enters the upper Bay is deposited, a small amount is carried further down stream and a significant portion is lost to organic oxidation (Biggs, 1970).

4.2.2. Sediment Quality of Upper Bay and Pooles Island Area

Environmental regulations for defining the quality of sediment have not been established. There are values that have been generated by the EPA that are meant to be used as guidelines for evaluating contaminant levels; the no observable effect level (NOEL) refers to the concentration of a parameter at which no toxic effects have been observed, and the probable effects level (PEL) is the level at which toxic effects are probable. When available, NOEL and PEL values were used to evaluate sediment quality for various parameters. In addition, potential contaminants that were detected are compared to data from the outer channel of the Baltimore Harbor. Outer channel sediments are not considered to be contaminated by the State of Maryland.

CENAB performed sediment sampling and chemical analysis at a reference station near Pooles Isla d in Fall 1995 (EA Engineering, 1996). This information is provided in Appendix C. The chemical constituents discussed below are those which were detected. Sediment metal concentrations are characterized as similar or less than those typical of outer channel material. The following trace metals have established NOEL and PEL concentration values (Appendix C): arsenic, cadmium, chromium, copper, lead, mercury and zinc. Chromium, copper and lead values for sediments at Pooles Island are below the NOEL and arsenic, cadmium, mercury and zinc for sediments at Pooles Island are well below PEL values. Two semivolatile polycyclic aromatic hydrocarbons were detected in the Pooles Island sediments: benzo(b)flouranthene, for which NOEL and PEL values have not been developed; and phenanthrene which was below the NOEL (Eskin *et al.*, 1996). Though trace metals and two semivolatile polycyclic aromatic hydrocarbons were detected in the Pooles Island sediments, they were below NOEL and/or PEL limits or the NOEL/PEL limits have not been defined yet. No studies to date have stated that sediments in the Pooles Island area are considered contaminated.

4.2.3. Sediment Quality of Dredged Material from Channel

The C&D Canal northern approach channels will be the source of dredged material used for placement in G-East and Site 92. Sediment quality analysis from the C&D Canal approach channels is similar to those which have been characterized as non-contaminated (Appendix C). Contaminant concentrations are generally below guideline values for organics and metals. Although some lead values (Versar, 1994) were higher than the PEL values, they are well within the EPA "safe" levels (MES, 1993). In addition, ammonia-nitrogen and zinc were at concentrations greater than EPA ambient water quality criteria (AWQC). To determine if these levels were toxic, toxicity tests using the amphipod *Leptocheirus plumulosus* were conducted. Survival rates of the amphipod were above 90%. Therefore, these tests indicated that sediment from the approach channels was not toxic (Versar, 1994).

4.2.4. Nutrients

Phytoplankton communities are a crucial part of the Bay's ecosystem for nutrient cycling (Correl, 1987). Therefore, effects of nutrient loading on the phytoplankton community have been extensively studied in an effort to better understand and thereby improve the nutrient levels of the Bay. Phytoplankton communities tend to be limited by one nutrient: nitrogen, phosphorus, or silica; meaning that net increases in concentrations of a non-limiting nutrient do not produce significant increases in primary productivity, but net increases in the limiting nutrient create significant growth reactions in certain sectors of the community during the growth season. Nutrient releases to the water column naturally increase during the growing season due to increased microbial metabolism in the bottom sediments (Correl, 1987). Algal blooms, which increase light attenuation problems, are linked to hypoxia which in turn is linked with nutrient regeneration.

The Chesapeake Bay functions as a source and a sink for nutrients with nutrients and organic matter entering the Bay from a variety of sources. Dissolved nutrients are rapidly incorporated into particulate matter by biological, chemical, and physical mechanisms. This particulate matter sinks to the bottom and is available for remineralization. The large amount of nutrients stored in the bottom sediments ensure a large flux of nutrients from the sediments to the water column thereby sustaining phytoplankton growth (Boynton *et al.*, 1996a). As an important management strategy to assist in controlling external loading of nutrients in the Bay, primarily by the Susquehanna River in the upper Bay, the Chesapeake Bay Program has agreed on a 40 percent nutrient reduction goal for nitrogen and phosphorous compounds (CBP, 1994).

Phytoplankton productivity and chlorophyll levels in the upper Bay are naturally depressed, compared to areas further South, due to the turbidity (Ruddy, 1990). The upper Bay is characterized by high DO levels and a well mixed water column due to tidal currents and winds (Versar, 1993; Boynton *et al.*, 1994; Neubauer and Thomas, 1996). Because of this, the upper Bay does not develop summer hypoxic conditions (Ruddy, 1990). The turbulence and small vertical density differences in the upper Bay also aid in nutrient exchange between sediments and the water column (Flemer and Biggs, 1971).

The upper Bay is strongly influenced by the Susquehanna River which is the major contributor of freshwater to the upper Bay. Therefore, it is the primary factor influencing the salinity regime and inorganic silt load, and thereby, the nutrient levels due to influx of nitrogen and phosphorus (Clark *et al.*, 1973; CBP, 1994). The upper

Bay also experiences moderate fluxes in sediment-oxygen levels and nutrient exchange rates (Boynton *et al.*, 1996a).

Sediments in the upper Bay contain significant amounts of carbon, nitrogen, phosphorus, and other compounds representing the potential "water quality memory" of the Bay (Boynton *et al.*, 1996a). This cycling of nutrients from the water column to sediments and back to the water column is in conjunction with higher phytoplankton productivity in the spring and again in fall.

Water column studies by UMCEES of G-East and Site 92 during Summer 1996 found that dissolved nutrient concentrations were within expected ranges for the Pooles Island area (Boynton *et al.*, 1996a). Ammonium concentrations and dissolved inorganic phosphorous (DIP) concentrations were moderate, and nitrite concentrations were low. Nitrite plus nitrate and silicate concentrations were high which was a reflection of the riverine sources of these compounds. Nitrite plus nitrate fluxes were directed into the sediments representing a loss of nitrogen from the water column.

Sediments in G-East and Site 92 were oxidized at the surface and to 10 cm below the surface. This oxidized condition results in phosphorus remaining attached to inorganic particles and not being diffused back into the water column and nitrogen loss to the atmosphere representing a natural nitrogen sink. Therefore, chlorophyll-a levels were low and sediment-water nutrient fluxes were also low due to the limited supply of labile organic matter. Sediment oxygen consumption was large compared to other zones of the Bay but this does not pose a threat to oxygen conditions due to the well-mixed water column in the upper Bay. When compared to typical stoichiometry of organic material depositing to sediments in estuaries such as the Chesapeake Bay, sediment particulate nitrogen (PN) concentrations were low relative to the amount of sediment particulate carbon (PC) present. This low PC:PN ratio indicated that much of the sediment organic matter was probably not available to organisms for food or to decomposers as substrate. Sediment particulate phosphorus (PP) levels were high compared to PC indicating that PP is binding to sediment particles as they encounter saline water (Boynton *et al.*, 1996a).

In summation, nutrient levels in the study areas are subject to moderate variability due to input from the Susquehanna River, hypoxia is not common, phytoplankton productivity is low due to turbidity, nutrient levels are low to moderate, and sediment nutrient transport is negligible due to the significant vertical water column mixing through wave and tidal action (Boynton *et al.*, 1996a).

4.3. BIOLOGICAL ENVIRONMENT

4.3.1. Water Quality

G-East and Site 92 are adjacent to pre-existing and on-going dredged material placement sites. Dredged material placement has several potential impacts on estuarine water quality. Of primary interest are nutrient releases from sediments to the water column, turbidity, light attenuation increases associated with suspended sediments and the increase of chlorophyll-a concentrations (phytoplankton indicator) that are indicators of eutrophication problems. Also of concern to water quality is the dissolved oxygen (DO) content of the water. DO is essential to biota because, unlike terrestrial species, aquatic species have mechanisms that utilize DO in the water column to survive.

As part of the Chesapeake Bay Monitoring Program (CBMP), the Chesapeake Bay Mainstem has been monitored since 1984. This program includes three stations in the upper Bay. Water quality parameters being tracked in the upper Bay include: Total Suspended Solids (TSS), DO, nitrogen species, phosphorous species, and chlorophyll-a.

Figures 4-2, 4-3, 4-4 and 4-5 illustrate the observed conditions at water quality monitoring station MCB3.1, which is located just under two miles southeast of Pooles Island and Area G-East and Site 92. Nine years of data for these water quality components are shown in these figures (1987 to 1995). The results are a reasonable representation of water quality conditions in the Pooles Island area.

Material has been placed in the Pooles Island region since 1965 (Halka and Panageotou, 1992). Potential impacts on water quality associated with dredged material placement include increased turbidity, nutrient loading and release and/or subsequent algal growth, and loss of habitat and species through development of hypoxic conditions. To assist in understanding potential impacts of dredged material placement on existing water quality conditions in the Pooles Island area, baseline, during and post-placement events have been extensively monitored and documented. A comprehensive set of physical, chemical, and biological parameters have been investigated. To insure negligible effects on existing water quality conditions, placement of dredged material in the study area has primarily occurred in the period of October through March (Cronin *et al.*, 1970; Greeley-Polhemus *et al.*, 1993).

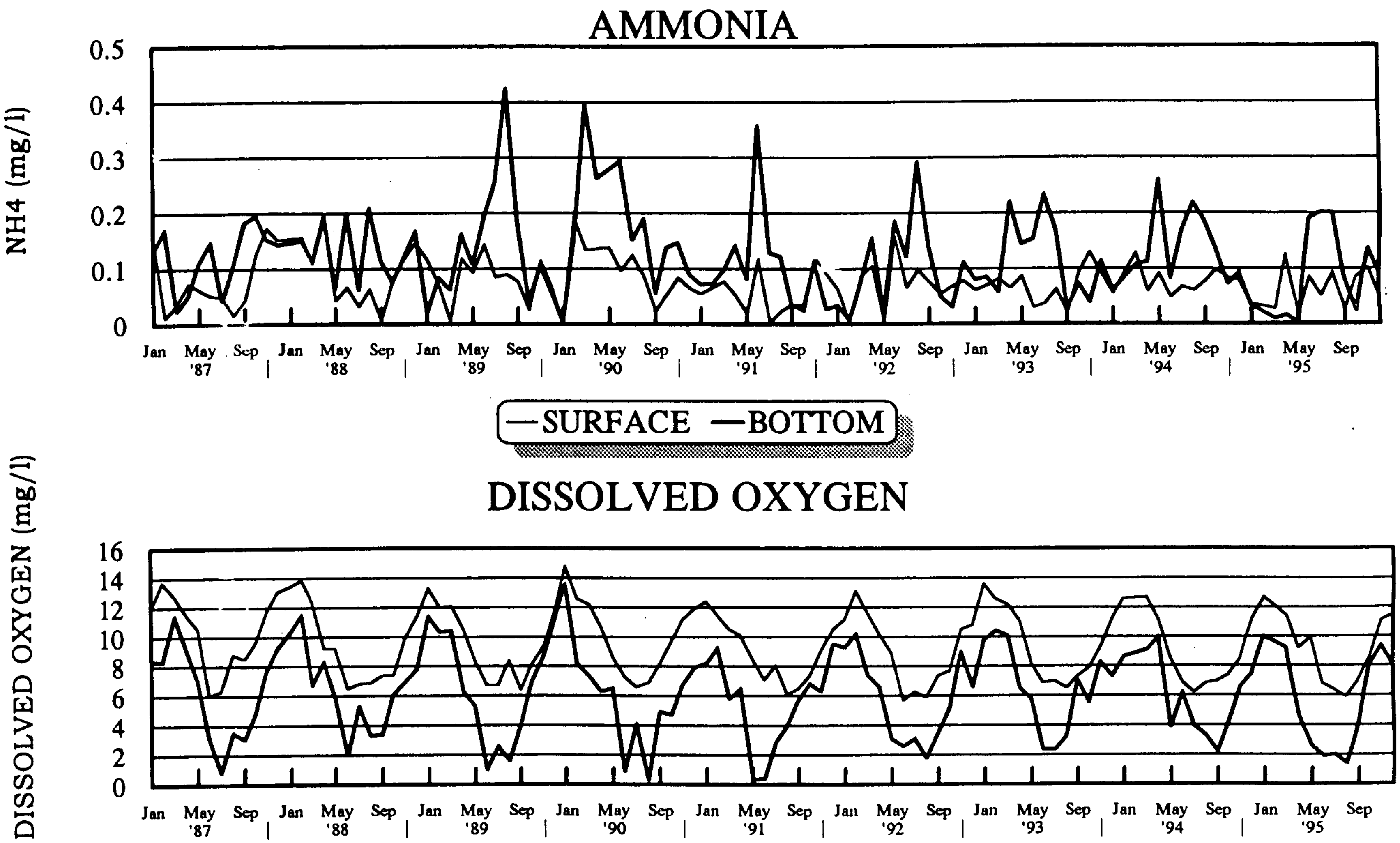


Figure 4-2: Water Quality Data For Pooles Island Area From Water Quality Monitoring Station MCB3.1

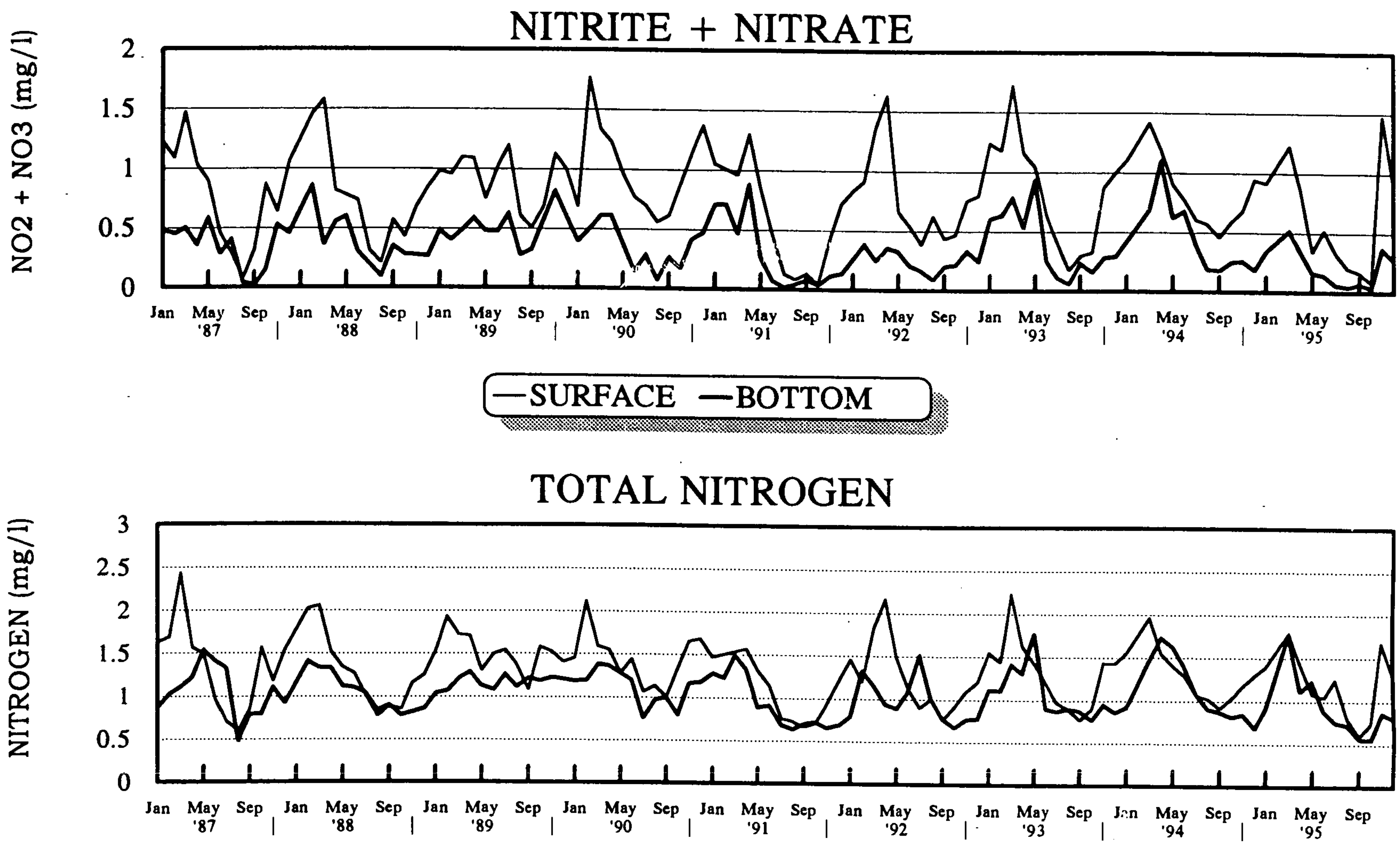


Figure 4-3: Water Quality Data For Pooles Island Area From Water Quality Monitoring Station MCB3.1

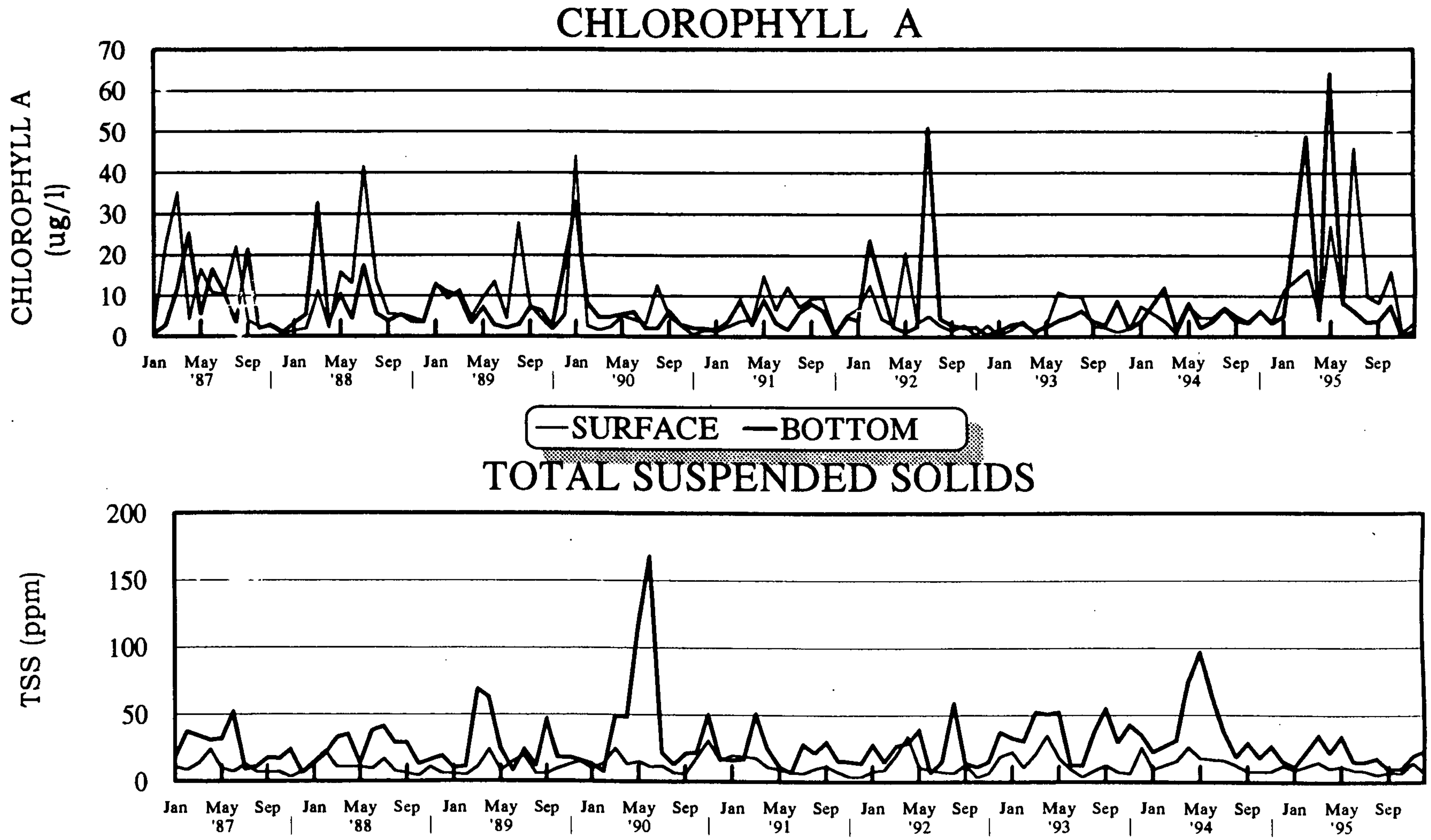


Figure 4-4: Water Quality Data For Pooles Island Area From Water Quality Monitoring Station MCB3.1

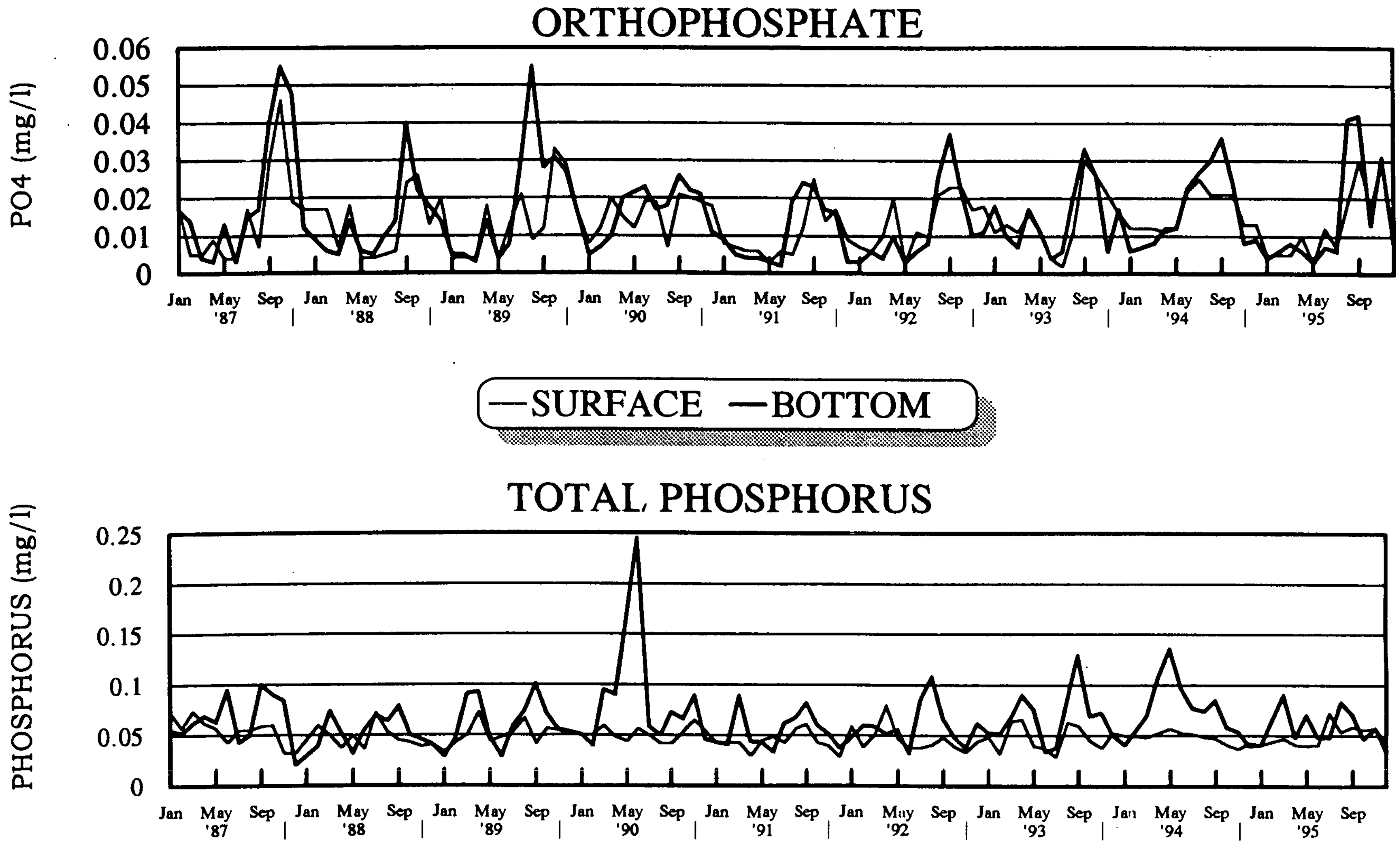


Figure 4-5: Water Quality Data For Pooles Island Area From Water Quality Monitoring Station MCB3.1

4.3.1.1. Dissolved Oxygen

DO has a significant impact on living organisms and their habitats. The decline of dissolved oxygen in the Chesapeake Bay is an important indicator of this estuary's water quality and health. DO concentrations in the Bay vary depending on the time of year and depth of water. Dissolved oxygen is high during the winter, and in the spring, as water temperatures rise, levels decrease (PCOE, 1996). Oxygen depletion in the Bay is also influenced by the spring flow of the Susquehanna River and the intensity of vertical density stratification during the summer (Sea Grant College Programs of Maryland and Virginia, 1992). Hypoxic or anoxic conditions are usually encountered in the deeper parts of the Bay and occur during the summer months. Anoxic conditions can lead to the loss of habitat and decline of benthic organisms. Benthic organisms and elevated phytoplankton populations can consume and significantly decrease oxygen levels. However, phytoplankton populations are low in the upper Bay (Lacouture *et al.*, 1993). Therefore, hypoxia or anoxia occurrences because of consumption of oxygen is minimal.

In the Pooles Island area of the Chesapeake Bay, the well mixed water column, due to tidal and wave action during the winter and spring months, prevents the development of hypoxic or anoxic conditions (Figure 4-2) (PCOE, 1996). During the summer, hypoxia and anoxia usually pose a greater threat to the environment. However, studies show that in the Pooles Island area dissolved oxygen concentrations of bottom waters, during June through August, 1994-1996, were greater than 80% of saturation indicating no oxygen stress of bottom waters (Boynton *et al.*, 1996a).

4.3.1.2. Turbidity

Turbidity strongly impacts the amount of light penetrating through the water column and corresponding phytoplankton productivity, and has direct impacts on aquatic resources. High turbidity blocks the rays of the sun from reaching down into the water column and restricts photosynthesis. The reduction of photosynthesis impairs the ability of shallow waters to support submerged aquatic vegetation (SAV) which in turn provide a food source for waterfowl and habitats for many estuarine organisms. As turbidity increases, so does the potential for several harmful effects on aquatic organisms such as abrasion and clogging of the respiratory membranes and gills of fish and macroinvertebrates, as well as increased nutrient concentrations in water causing favorable conditions for large algae blooms (PCOE, 1996). The resulting large population of algae block out the light as well, and the subsequent die-off and decomposition helps to decrease the concentration of dissolved oxygen in the water column.

The upper Bay exhibits high turbidity most of the year due to suspended organic and mineral material contributions from the Susquehanna River and wind induced turbulence (PCOE, 1996). During the fall and spring, turbidity is at its highest because of spring thaw and high river flow. Turbidity increases with depth with the maximum level occurring near the bottom (Schubel, 1968b). The Pooles Island area of the Bay is described as the estuarine turbidity maximum zone (Schubel, 1968b). The turbidity maximum zone, a zone of suspended sediment concentration, is produced and maintained by the periodic resuspension of bottom sediment by tidal scour and by the sediment trap produced by the net non-tidal circulation (Schubel and Hirschberg, 1980). The zone is characterized by turbidities and suspended sediment concentrations greater than those found either upstream in the source river or farther seaward in the estuary (Schubel, 1968b).

4.3.2. Submerged Aquatic Vegetation

SAV is a very important component of the Chesapeake Bay ecosystem. SAV communities can contribute much to the primary and secondary productivity of an estuary. They provide food and nursery habitat for many species and help to consolidate sediment and reduce turbidity by decreasing wave energy. They also absorb nutrients and produce oxygen (Hurley, 1990). Because SAV has specific habitat requirements, their presence can be used to evaluate the water quality of a given area. The minimal requirements for a given species are defined by the following parameters: light attenuation coefficient, total suspended solids, chlorophyll-a, dissolved inorganic nitrogen and dissolved inorganic phosphorus (Dennison *et al.*, 1993).

Historically, expansive communities of SAV contributed to the high productivity of the Bay but dramatic SAV declines in the late 1960's and 1970's have elucidated a degradation of the Bay's water quality. Baywide SAV coverage and density has increased in recent years (Orth *et al.*, 1994). The rates of recovery are not constant for different areas of the Bay. Certain tributaries and areas of the Bay still have not met the minimal habitat requirements for SAV (Orth *et al.*, 1994). Land use can have a profound effect on the SAV habitat requirements in a given area since it can determine the loadings of nutrients and sediment (Hurley, 1990).

Recent ground-surveys (Summer and Fall of 1995) in the Pooles Island area verified the presence of a number of SAV species. Eurasian watermilfoil (*Myriophyllum spicatum*) was found in Worton Creek by local citizens and Common elodea (*Elodea canadensis*), Eurasian watermilfoil, Coontail (*Ceratophyllum demersum*), and Wild celery (*Vallisneria americana*) were found in ground surveys by local citizens and Harford Community College in the Gunpowder River (Orth *et al.*, 1996). Ground-surveys by the Army Environmental Center at APG of the Gunpowder River and Pooles Island in 1996 verified the presence of the following species of SAV: Common elodea, Eurasian watermilfoil, Naiads (*Najas gracillima*), Muskgrass (*Nitella* *flexilis*), Curly pondweed (*Potamogeton crispus*), Redhead grass (*Potamogeton perfoliatus*), Wild celery, and Horned pondweed (*Zannichellia palustris*). Wild celery and Redhead grass were found in the eastern cove of Pooles Island (Julie Bortz, APG, pers. comm., Jan. 1997). Other SAV species that could potentially inhabit the upper reaches of the Bay (based on salinity tolerances), including the Pooles Island area, are: Water stargrass (*Heteranthera dubia*), Hydrilla (*Hydrilla verticillata*), Southern naiad (*Najas guadalupensis*), Sago pondweed (*Potamogeton pectinatus*) and Widgeon grass (*Ruppia maritima*) (Funderburk *et al.*, 1991; Batiuk *et al.*, 1992). The SAV documented in the eastern cove of Pooles Island are the closest recorded location to the proposed placement sites. The SAV were approximately 3500 feet from G-East and 5000 feet from Site 92.

Because of their light availability requirements, SAV in the Chesapeake Bay are limited to shallow waters, generally less than two meters in depth (Batiuk *et al.*, 1992). No SAV species have been found in the proposed placement areas, G-East and Site 92, as they are both too deep to support SAV. These areas are also in the turbidity maximum zone within the Bay. The naturally high turbidity levels in this area of the Bay further contribute to the lack of available light for SAV at greater than 2 meters depth.

4.3.3. Benthic Macroinvertebrates

Benthic macroinvertebrates are those animals without internal skeletons which live on or in bottom substrates all or part of their lives (Versar, 1992). For study purposes, macroinvertebrates are those which are retained on a sieve with a 0.500 mm mesh opening size (Versar, 1992). Examples are bivalve mollusks such as clams and mussels, amphipods, crustaceans, annelid worms, and cnidarians. Benthos are an important link in the ecology of the Bay because they are secondary consumers of detritus and bacteria from the bottom and are in turn an important food source for juvenile fish, crustaceans and waterfowl.

Macrobenthic organisms are important food sources for many species of waterfowl, crustaceans, and juvenile fish. Miller and Sadler (1997) conducted stomach content analysis on 39 white perch and 38 striped bass collected from anchored gill nets in the Pooles Island area. Over fifty-one percent of the white perch stomach contents were crustaceans and amphipods. The remaining stomach contents included polychaetes (20%), stomatopods (13%) and a variety of less represented material. Macrobenthics were less present in striped bass stomach contents. Seventy-four percent of all striped bass gut contents, by number, were fish, with the remaining items being crabs (10%) and unidentifiable material (16%).

Benthic macroinvertebrate species diversity and distribution in the upper Bay are lower than in areas south due to salinity and temperature fluctuations (Rogers and Rogers, 1986; Diaz and Schaffner, 1990; Ruddy, 1990). In the upper Bay, species diversity is highest in the spring and fall (Dalal, 1996a). Diversity of benthic communities is theoretically at a minimum at 7 ppt salinity (Gosner, 1971). This region has a low but variable diversity due to changes in the salinity regime two or more times a year.

The upper Bay benthic community is dominated by species known to prefer mud substrates and that can survive in a low-mesohaline to oligohaline environment with wide fluctuations in salinity and temperature. Studies have shown that habitats with mud substrate exhibit the lowest productivity versus mixed and sandy sediment habitats, although the highest productivity for habitats with mud substrate is when they are located in the low-mesohaline to oligohaline zones (Diaz and Schaffner, 1990). The upper Bay substrate is predominantly silty-clay, clayey-silt (mud) (Dalal, 1996a; Dalal, 1996b; MDNR, 1996). Sediments in Area G-East are characterized as 2-16% sand, 45-70% silt and 30-45% clay (Halka *et al.*, 1996). Sediments in Site 92 are characterized as 1 to 5% sand, 45 to 60% silt and 40 to 70% clay (Halka *et al.*, 1996).

Environmental factors such as substrate type and temperature and salinity fluctuations dictate that the upper Bay benthic community be dominated by opportunistic species which are less sensitive to environmental fluctuations and stresses and can recolonize an area quickly. It is generally accepted that the upper Bay is a naturally unstable environment which precludes establishment of a benthic community dominated by equilibrium species (Cronin *et al.*, 1970; Dalal, 1996a; Dalal,1996b).

The benthic community of the upper Bay is dominated by three groups - mollusks, arthropods, and polychaetes. These organisms are dominant because of their ability to avoid wide fluctuations in temperature and salinity by burrowing into soft sediments and constructing semi-permanent tubes (Cronin *et al.*, 1970; MDNR, 1995a). The dominant benthic community species composition found in the upper Bay as described by Cronin *et al.* (1970), Dalal (1996a), Ruddy (1990), Neubauer and Thomas (1996), Scott *et al.* (1988), Rogers and Rogers (1986), Greeley-Polhemus and RMC Environmental (1994), and MDNR (1996) is:

Cyathura polita (arthropod)
Heteromastus filiformis (polychaete)
Leptocheirus plumulosus (arthropod)
Marenzelleria (Scolecolepides) viridis (polychaete)
Rangia cuneata (mollusk)

Research has shown that polychaetes are most productive in mesohaline zones with mud and mixed sediment (Diaz and Schaffner, 1990). Polychaetes are one of the prevalent groups (examples listed above) that represent the existing benthic community and the community that rapidly recolonized the placed material in areas such as G-South and exist in reference areas from the upper Bay.

Research in and around G-East in 1995 and in G-South in 1996 has shown that these areas met Chesapeake Bay restoration goals as defined by the Chesapeake Bay Benthic Restoration Goals Index and the Chesapeake Bay Benthic Index of Biotic Integrity (Dalal *et al.*, 1996a; Dalal *et al.*, 1996b). Benthic communities in both areas were generally healthy but had a low diversity index and number of taxa. The areas were dominated by *Rangia cuneata*, *Marenzelleria viridis*, *Leptocheirus plumulosus* and *Cyathura polita* at the time of sampling. Prior to this 1996 benthic analysis, G-South was utilized for placement in 1993. G-South was again utilized for placement during the 1996/1997 placement window, after this last benthic analysis. Since this area met restoration goals in 1996, after placement in 1993 and prior to placement in 1996/1997, it can be deduced that the benthic population was able to recover over time after placement activities ended. Although there is no pre-placement data available to verify what pre-existing conditions were at G-South, reference areas nearby showed similar communities in the 1996 study. It is known from other research that the benthic community at G-South would have been substantially reduced, if not completely removed, as a result of placement activities (Cronin *et al.*, 1970; Ruddy, 1990; Ranasinghe and Richkus 1993; Versar, 1994).

Species abundance and biodiversity measures indicated no significant differences in placement areas at Pooles Island compared to an upper Bay reference station outside the area of dredged material placement (Versar, 1992). Past studies have indicated that benthic repopulation of placement areas occurs within 18 months of the end of placement (Cronin *et al.*, 1970; Ruddy, 1990; Ranasinghe and Richkus, 1993; Versar, 1994).

The method used to calculate species diversity is the Shannon Weaver diversity index (Spain, 1982). Species diversity indices for the existing G-West placement area were 2.53 in Summer 1993 before berm placement, 1.61 in August 1994 after berm placement and 2.15 in September 1995 after hydraulic placement. These values were just slightly lower than reference areas during all three years (2.77 - Summer 1993, 2.32 - August 1994, 2.32 - September 1995). In September 1996 in G-South, the species diversity index was 1.93 versus 2.52 in the reference area. There were 8 taxa present in G-South versus 13 in the reference area (Dalal *et al.*, 1996b). The average species diversity indices for the G-East study area, which included sample points south of G-East, in September 1996 was 1.97 versus 2.24 and 2.34 in the two reference areas. There were 10.2 taxa in the G-East study area in 1996, versus 8.0 and 10.0 taxa in the reference areas (Dalal *et al.*, 1996a). As stated previously, G-South and the G-East study area met Chesapeake Bay restoration goals in 1996, even though G-South had been used until 1993 as a placement area.

4.3.4. Plankton

4.3.4.1. Phytoplankton

Phytoplankton are tiny, single-cell algae that drift about with the motion of the water. These single-cell algae are one of the primary producers of the food web and are a direct food source for animals in the water column and sediments. Because phytoplankton contain chlorophyll they are limited to the euphotic zone. The euphotic zone in the upper Bay is relatively shallow and turbid. The high turbidity and the widely fluctuating salinity in the upper Bay causes low phytoplankton biomass (Lacouture *et al.*, 1993).

Phytoplankton production and chlorophyll-a concentrations are highest during the warm season (May-Oct.) (Boynton *et al.*, 1982). The Chesapeake Bay Water Quality Program found that the general trends at the oligohaline stations (Pooles Island area) from 1984 to 1992 were a late spring-summer maximum in biomass and a summer maximum in productivity (Lacouture *et al.*, 1993). These studies also found that the phytoplankton population in the upper Bay is dominated by diatoms and dinoflagellates and supplemented by aperiodic dinoflagellate blooms in winter and early spring. Diatom populations dominated in the spring (*Cyclotella* sp., *Thalassiosira* sp., unidentified pennates) and fall (unidentified pennates, *Skeletonema costatum*, *Cyclotella* sp.); in summer, dinoflagellates co-dominated. Studies have shown that dinoflagellates have a higher light optima, shorter generation times, and are motile whereas diatoms have a lower light optima, longer generation times, and a greater capacity for energy storage, but require mixing to remain suspended (Lacouture *et al.*, 1993).

Distribution of phytoplankton is regulated by light, salinity, temperature, nutrients, predation, circulation patterns, winds, DO concentrations, and competition. Fisher *et al.* (1994) has shown that both nitrogen and phosphorus limit phytoplankton growth during different seasons and in different locations in the Chesapeake Bay system. Due to the distance from the ocean, which supplies much of the phosphorus to the lower Bay, the upper Bay is generally considered phosphorous limited, that is, more phosphorus results in more phytoplankton growth, but more nitrogen usually does not (Boynton *et al.*, 1995). Because phytoplankton are regulated by environmental variables, productivity varies from year to year. Generally, phytoplankton in the Bay are considered extremely productive when compared to the open ocean (Day *et al.*, 1989).

4.3.4.2. Zooplankton

The term zooplankton widely describes aquatic and marine microscopic animals. Within this general category are crustaceans such as copepods and the water flea, fishes in egg and larval stages (ichthyoplankton), and other pelagic microscopic animals which are at the mercy of water currents. Zooplankton, one of the most abundant group of animals on the earth, provide a vital link in the food web. These free swimming selective feeders are capable of consuming large quantities of phytoplankton and detritus and their enormous abundance constitute a primary source of food for larval stages of fishes and other planktonic feeders.

A survey conducted by Burton and Brindley (1994) for the Sparrows Point Shoreline Reclamation project sampled zooplankton at three stations in the Chesapeake Bay: Sparrows Point, Baltimore Harbor and the Upper Main Stem of the Bay (immediately south of Shad Battery Shoal). Primary species collected in all sites were calanoid copepods *Acartia tonsa* and cyclopoid copepods *Oithona colcarva,* and *Eurytemora affinis*. In addition, the following were present at each station: the parasitic copepod *Ergasilus* sp., harpactacoids, ostracods, polychaete larvae, barnacles, copepod nauplii, and the cladoceran, *Monina* sp. Species diversity was greatest at the upper Bay site, and included many freshwater species (Burton and Brindley, 1994).

Salinity appears to control the distribution of many these estuarine species, primarily because of physiological processes and the osmotic stress caused by the salt content of the water. Some organisms have a limited ability to withstand salinity changes and may be restricted to a single salinity zone. In the upper Bay, salinity is influenced strongly by freshwater flows from the Susquehanna River. Burton and Brindley (1994) recorded either fresh or oligohaline waters throughout their 1994 study period (May - October). Subsequently, slightly greater densities (6,700-38,000/m^3) of the clanoid *E. affinis* were recorded at the Upper Mainstem of the Bay station, than *A. tonsa* during the months of May, June, and July (typically a period responsive to spring freshets). *A. tonsa* densities between 811-27,839/ m^3 were reported for all other locations and months of the study period (August, September and October).

Zooplankton based indices are being developed to quantify and thus qualify health of larval fishes such as the striped bass. Studies suggest poor survival of striped bass year classes in the Chesapeake Bay due to larval starvation can be attributed to rapid declines in populations of zooplankton prey organisms (Wright *et al.*, 1985; Waters, 1993). For example, in 1977 low numbers of striped bass young-of-the-year coincided with precipitous drops in temperature and zooplankton densities (Setzler-Hamilton *et al.*, 1987.)

Rutherford (1992) proposed a number of density-independent factors which appeared to affect good fish recruitment in the upper Bay: high striped bass egg production, pH values and water temperature, and zooplankton abundances. These factors had a negative effect on larval survival, larval growth rate and recruitment (Rutherford, 1992; Uphoff, 1989). Rutherford (1992), found significant correlations between these vital rates, abundance of striped bass larvae and the juvenile index. These correlations indicated that year-class strength may be determined during the larval stage, as the striped bass larvae feed on zooplankton.

Data has been collected on ichthyoplankton in the Chesapeake Bay to monitor fish species compositions for over 40 years. Plankton tows were initially used to identify spawning areas (Hollis, 1967) and are now used to investigate Bay-wide spawning trends, develop criteria to assess self-sustaining spawning stock levels, and evaluate spawning population recovery (Uphoff, 1994; MDNR, 1995). In general, ichthyoplankton abundance in the upper Bay, which includes the Elk River, has followed trends seen in juvenile indices for striped bass. Over the past twenty years, ichthyoplankton present in plankton net tows in the upper Bay has fluctuated from greater than 80% in the early 60's, to below 70% in the early 70's, after which the percentage rose again to above 80% through the end of the 70's. From the end of the 70's to the early 80's, ichthyoplankton plummeted to below 40% but has been on a steady incline since the early 80's. By 1995 the presence of ichthyoplankton in plankton net tows had risen above 80%, indicating the potential for a high striped bass recruitment rate (Uphoff, 1997).

4.3.5. Fisheries

Marine, freshwater, estuarine, anadromous and catadromous species of finfish all utilize the upper Chesapeake Bay at some point in their life cycles. The composition in the upper Bay varies markedly with temperature and salinity conditions. Abundance and species diversity is greatest from the summer to early autumn and lowest in winter (PCOE, 1996). Several shellfish species also inhabit the upper Chesapeake Bay. While there exists a plethora of known shellfish and finfish species in the upper Bay, the anthropogenic value of a species is viewed both in terms of its ecological and economic role. The following sections discuss the shellfish and finfish species common to the upper Bay, present information from studies conducted in the Pooles Island area for the EA, and present information from literature and database reviews of studies performed in the Upper Bay. Species were selected for discussion based on their known ecological and economic importance in the upper bay, and their potential to be impacted by the placement of dredged material.

4.3.5.1. Shellfish

Three species were considered as the target shellfish species in the Pooles Island area. These target species were chosen due to their role in Maryland commercial and recreational resources, their ecological importance and their potential sensitivity to the dredged material operations window. Target shellfish species discussed in this EA and potentially found in the upper Bay include the blue crab (*Callinectes sapidus*), Eastern oyster (*Crassostrea virginica*) and soft-shell clam (*Mya arenaria*). Basic habitat requirements, life histories and other pertinent information these shellfish species are presented in detail in Appendix B.

Although adult blue crabs are ubiquitous in the Chesapeake Bay, the upper Bay is relatively unimportant to the critical periods of its lifecycle. Winter dredging data from the MDNR have found that the area surrounding Pooles Island has lower densities of blue crabs than the upper Bay as a whole. Additional observations have found that very few blue crabs are found to inhabit the substrate around Pooles Island in the winter. The silty mud which contains high densities of *Rangia cuneata* is not suitable overwintering habitat for the blue crab (Jordan, MDNR, pers. comm., Nov. 1996).

Although there is an abundant fossil oyster shell resource in the upper Bay, live oysters were not found during recent surveys of the Pooles Island area (Judy, MDNR, pers. comm., Feb. 1997). There are a number of oyster bars that have been historically productive in this portion of the upper Bay, but the Pooles Island area is not considered productive habitat for oysters. Phoenix Shoal to the northeast and the Coal Lumps to the southeast are the closest live oyster reefs to Pooles Island, yet they are still far enough away not to be disturbed by the placement of dredged material in G-East and Site 92. Coal Lumps, the northernmost oyster bar and closest live oyster bar to G-East and Site 92, has been harvested in recent years but is located approximately 3,000 feet (900 m) away from G-East and Site 92 (Judy, MDNR, pers. comm., Feb. 1997).

Presently there is no commercial clamming in the Pooles Island area. The Tolchester area is the northernmost point for the commercial harvest of soft shell clams (Judy, MDNR, pers. comm., Feb. 1997).

4.3.5.2. Finfish

Fish studies conducted in the upper Bay and information from commercial and recreational databases provided by MDNR, have documented many common upper Bay finfish species (MES, 1997aA; Weimer *et al.*, 1996; Miller and Sadler, 1997). Table 4-1 presents a list of these common upper Bay finfish species.

For purposes of this EA, several finfish species were identified as target species. These target species were selected because of their role in Maryland commercial and recreational resources, their ecological importance or their potential sensitivity to the dredged material operations window. These target finfish species include the Bay anchovy *(Anchoa mitchilli)*, alewife *(Alosa pseudoharengus)*, blueback herring *(Alosa aestivalis)*, American and hickory shad *(Alosa sapidossima and Alosa mediocris)*, Atlantic menhaden *(Brevoortia tyrannus)*, catfish species *(Ictalurus sp.)*, spot *(Leistomas xanthuras)*, striped bass *(Morone saxatilis)*, white perch *(Morone americana)*, winter flounder *(Pseudopleuronectes americanus)* and yellow perch *(Perca flavescens)*. Basic habitat requirements, life histories and other pertinent information for these finfish species are presented in detail in Appendix B. Many of these target finfish species were represented in the studies conducted for this EA.

Table 4-1: Finfish Species Common to the Upper Bay

Scientific Name	Common Name
Engraulidae	Anchovies
Anchoa mitchilli	bay anchovy
Percichthyidae	Bass, Temperate
Morone americana	white perch
Morone saxatalis	striped bass
Pomatomidae	Bluefish
Pomatomus saltatrix	bluefish
Ictaluridae	Catfish, Freshwater
Ictalurus punctatus	channel catfish
Ictalurus catus	white catfish
Ictalurus nebulosus	brown bullhead
Ictalurus natalis	yellow bullhead
Sciaenidae	Drums
Cynoscion regalis	weakfish
Leistomas xanthuras	spot
Micropogon undulatus	Atlantic croaker
Pogonias cromis	black drum
Anguillidae	Eels, Freshwater
Anguilla rostrata	American Eel
Bothidae	Flounder, Lefteye
Paralichthys dentatus	summer flounder
Pleuronectidae	Flounder, Righteye
Pseudopleuronectes americanus	winter flounder
Gobiidae	Gobies
Bobiosoma bosci	naked goby
Exocoetidae	Flying Fishes
Hyporhamphus unifaciatus	halfbeak
Clupeidae	Herrings
Alosa aestivalis	blueback herring
Alosa pseudoharengus	alewife
Alosa sapidissima	American shad
Alosa mediocris	hickory shad
Brevoortia tyrannus	Atlantic menhaden
Dorosoma cepidianum	gizzard shad
Dorosoma petenense	threadfin shad

Table 4-1 (cont.): Finfish Species Common to the Upper Bay

Scientific Name	Common Name
Cangidae	Jacks and pompanos
Caranx hippos	crevalle jack
Cyrinodontidae	Killifishes
Fundulus heteroclitus	mummichog
Fundulus majalis	striped killifish
Fundulus diaphanus	banded killifish
Cyprinidae	Minnows and carp
Cyprinus carpio	carp
Hybognathus nuchalis	silvery minnow
Notemigonus crysoleucas	golden shiner
Notropis husonius	spottail shiner
Belonidae	Needlefish
Strongylura marina	Atlantic needlefish
Percidae	Perch
Perca flavescens	yellow perch
Etheostoma olmstedi	tesellated darter
Atherinidae	Silversides
Menidia menidia	Atlantic silverside
Menidia beryllina	inland silverside
Membras martinica	rough silverside
Soleidae	Sole
Trinectes maculatus	hogchoker
Acipenseridae	Sturgeon
Acipenser oxyrhynchus	Atlantic sturgeon
Acipenser brevirostrum	shortnose sturgeon
Centrarchidae	Sunfish
Lepomis gibbosus	pumpkinseed
Lepomis macrochirus	bluegill
Micropterus salmoides	largemouth bass
Pomoxis nigromaculatus	black crappie
Batrachoididae	Toadfish
Opsanus tau	oyster toadfish

4.3.5.2.1. Juvenile Fish Surveys in the Upper Bay

Annual fish indices are often used by fisheries managers to provide an early indication of future adult populations as they document annual variation and long-term trends in abundance and distribution. The MDNR Estuarine Juvenile Finfish Survey (EJFS) is used in the evaluation and management of many Chesapeake Bay finfish species and their habitats (MDNR, 1995b). Twenty-two permanent stations in the Maryland waters of the Bay comprise the EJFS and have been sampled three times each summer (July, August, September), annually since 1954 (MDNR, 1995b).

The primary focus of the EJFS is on striped bass and estimates year-class strength based on an index of young-of-year (YOY) abundance throughout the Chesapeake Bay. However, other studies have been conducted which evaluate the EJFS data and include species in addition to striped bass, such as alewife, blueback herring, white perch, channel catfish and American shad. White perch are typically the most plentiful fish captured in the beach seine, followed by striped bass and blueback herring. Alewife and channel catfish numbers are variable, and American shad are infrequently found during the annual surveys.

Utilizing the EJFS database, Vaas and Jordan (1990) examined the trends and interspecies correlation of bay-wide abundance indices of 19 species of estuarine fish. The study demonstrated various approaches to the use of long term biological monitoring data in an ecological context. Results showed many significant positive and negative similarities between the 19 fish species. Trends in the last decade suggest that species, such as the striped bass, American shad and other herring species are starting to return to historic, and supposedly healthy, levels of abundance (Vaas and Jordan, 1990).

The MES performed an analysis of the EJFS data collected by MDNR from the seven permanent Head-of-the-Bay stations for the PCOE. The stations included Tims Creek, Howell Point, Parlor Point, Welch Point, Hyland Point, Elk Neck Park and Ordinary Point. This study found that the following species were the most abundant in the EJFS at these stations over the period of 1958 to 1995: white perch, Atlantic silverside, striped bass, Atlantic menhaden, spottail shiner, bay anchovy, blueback herring, inland silverside, alewife and rough silverside (MES, 1997a). Between 1958 and 1985, numbers decreased for striped bass, alewife, blueback herring and American shad. This decrease reflected a pattern of increasing stress on these populations due to a combination of factors. The stressing factors could include a loss of spawning habitat, deteriorating water quality and increasing fishing pressure. Populations of these species are now probably increasing in part due to conservation measures such as moratoriums placed on striped bass, and American and Hickory shad, but also probably due to measures to better the biological environment of the Bay.

The MDNR uses the annual EJFS data to generate an index of relative abundance of striped bass for the purpose of modeling striped bass stock status. The MDNR reports this index in terms of a geometric mean, as calculations by this method are not sensitive to single year anomalies (MDNR, 1995b). The geometric mean is calculated for each of the four systems in the Bay and Baywide. The four systems are the Head-of-the-Bay, the Nanticoke River, the Choptank River and the Potomac River. The geometric mean for each of these systems is used to calculate the Baywide geometric mean. Since 1955, the EJFS data has had significant inter-annual fluctuation for all four systems and Baywide. In 1994, the geometric means for the various systems were calculated as follows (presented in declining order): Head-of-the-Bay (12.88), Nanticoke River (9.06), Choptank River (7.71), Baywide (6.40) and Potomac River (2.01). In 1996 the geometric means were calculated as follows (presented in declining order): Choptank River (33.29; an all time high for this system), Nanticoke River (18.80), Baywide (17.56), Head-of-the-Bay (15.00) and Potomac River (13.60) (MDNR, 1997).

Overall, when comparing the average geometric mean for the period from 1955 to 1996, the Head-of-the-Bay and the Choptank River systems had the highest averages of all four systems (5.82 and 5.55, respectively) and were higher than the Baywide average of 3.83. The Potomac River and Nanticoke River systems were lower than the Baywide average (3.35 and 3.09, respectively, versus 3.83 Baywide) (MDNR, 1997).

The MDNR compares the geometric mean average to the target period average (TPA), which is the average from 1959 through 1972. The TPA is the projected juvenile average assumed to be produced by a healthy population (MDNR, 1995b). The Head-of-the-Bay TPA is 7.27, the Potomac River TPA is 3.93, the Choptank River TPA is 5.00, the Nanticoke River TPA is 3.12 and the Baywide TPA is 4.32 (MDNR, 1995b). The 1996 geometric means for the four systems and Baywide were all higher than their respective TPAs; although the average geometric mean for the period from 1955 to 1996 for each system and Baywide was lower than their respective TPAs, except in the Choptank River where the average geometric mean was 0.55 higher than the TPA (MDNR, 1997).

Though there is significant inter-annual variability in the EJFS data from 1955 to 1996, the geometric mean for the Head-of-the-Bay does not appear to be significantly different than the Baywide geometric mean. Overall, when comparing the averages for the period from 1955 to 1996, the Head-of-the-Bay and the Choptank River have the greatest average geometric mean catch per haul. These values are greater than the average geometric mean catch per haul calculated Baywide and for the Potomac River system. The Nanticoke River has the lowest average geometric mean.

4.3.5.2.2. Fish Surveys in the G-East and Site 92 Areas

4.3.5.2.2.1. Trawl and Hydro-Acoustic Surveys

Fish abundance, size and species composition surveys have been conducted at G-West and reference areas seasonally since December 1992 to determine baseline conditions and monitor effects of dredged material placement in G-West (Weimer *et al.*, 1996; Brandt *et al.*, 1996a; Brandt *et al.*, 1996b; Brandt *et al.*, 1997). The study areas for the G-West project have included area G-East and approximately half of Site 92. Therefore, this data is appropriate for use in characterizing the fisheries in the proposed sites and also allows for an evaluation of the potential effects of dredged material placement in these areas on the fisheries.

The fisheries cruises have been conducted during the months of April, June, October and December. The baseline period ran from December 1992 to October 1993. Berm construction in G-West began in January 1994 and post-placement monitoring began in April 1994. The sampling areas, depicted in Figure 4-6, included G-West and three reference areas; the G-West sampling area included portions of Area G-Central and G-North and the majority of Area G-East. Reference areas A and B are within the Pooles Island area; Reference Area A includes approximately half of Site 92 and Reference Area B includes the C&D canal approach channel. Reference Area C is approximately 6 nautical miles south of Area A, off of Tolchester Beach, and primarily west of the channel. Area C was added as an additional reference area in 1994 because it is geographically removed and outside the influence of the Pooles Island study area (Weimer *et al.*, 1996).

Fish abundances and distributions in the upper Bay are highly dynamic and can vary seasonally, dielly, interannually, and in response to changes in temperature, salinity and oxygen conditions in the water column (Brandt *et al.*, 1994). Therefore, the fisheries studies were designed to sample during the day and night, during different seasons of the year and at varying depths. Nearby reference areas A, B, and C, were established as controls to help separate natural seasonal and interannual variability in fish abundance from any specific placement effects (Weimer *et al.*, 1996). The study methodology involved the use of acoustics as well as night midwater and day and night bottom trawls to characterize the fish abundance and distributions.

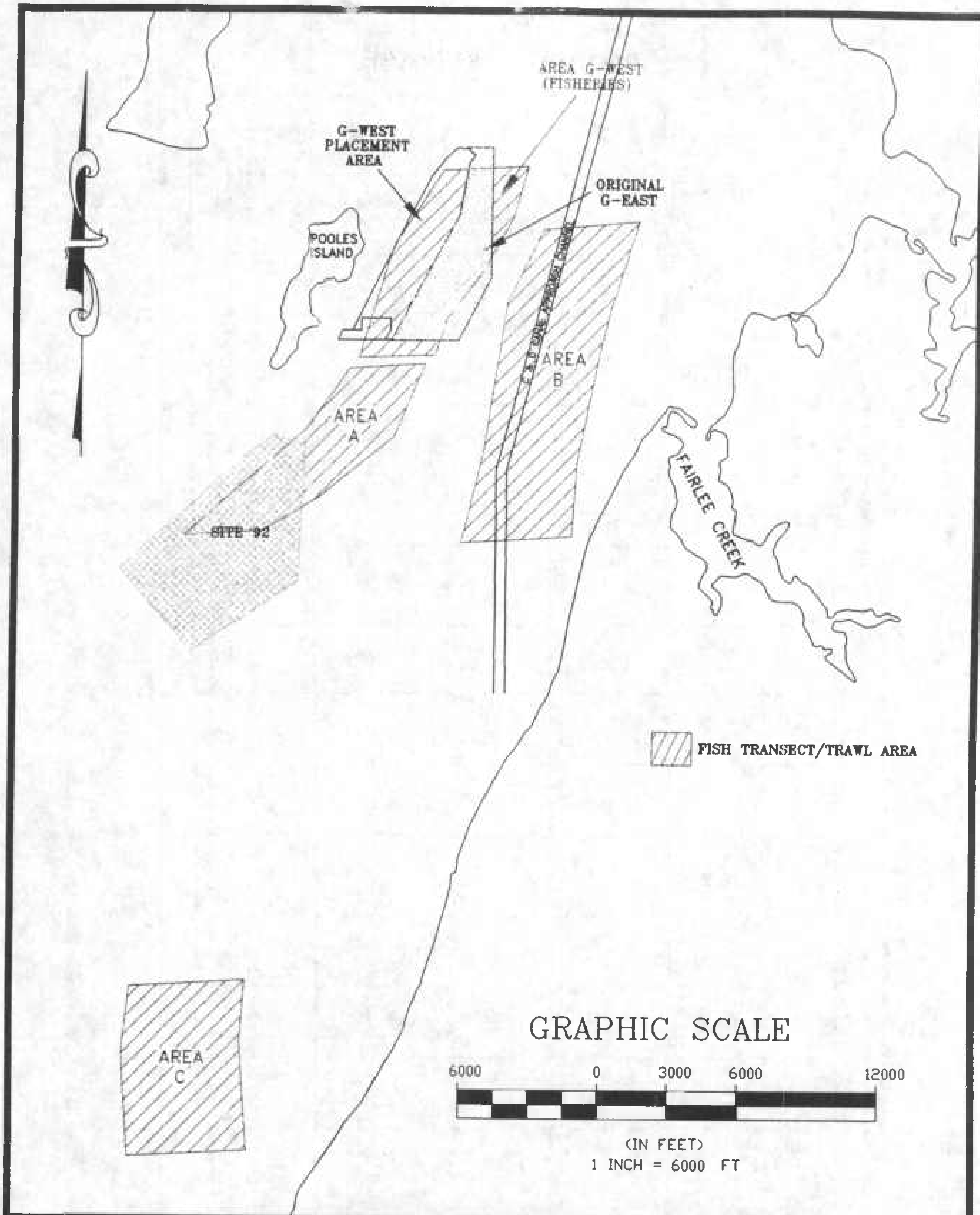
In general, the total number of fish collected in day and night bottom trawls in April and June of 1996 was higher than in previous years in all four areas, including the baseline period of 1993 (Table 4-2). This was attributed to the increase in channel catfish and striped bass numbers in April, and white perch numbers in June (Brandt *et* *al.*, 1996b). In October 1996, the total number of fish collected in the night bottom trawls were also higher than total numbers observed previously for all areas, except Area B. This was attributed to white perch and Bay anchovy abundances. The day bottom trawl total numbers, however, were lower than previous years for all sites except G-West. In December 1996, Areas B and C had the highest numbers to date in the day bottom trawls, due to white perch abundances, whereas Areas G-West and A had similar numbers to those observed since the baseline period. The total number of fish collected in the night bottom trawls in December 1996 was the lowest to date in Areas A and C, and similar to previous years in Areas G-West and B (Brandt *et al.*, 1997).

Increases in abundances, compared to baseline conditions in G-West, occurred during April 1995 and April and June 1996 in the day bottom trawls. In the night bottom trawls, increases in abundance, compared to baseline conditions in G-West, were observed in June and October 1996 (Weimer *et al.*, 1996; Brandt *et al.*, 1996b).

In 1995, night midwater trawls were dominated by Bay anchovy in April, June, and October. Overall, these species constituted 96.7% of the total fish caught in midwater trawls. No midwater trawls were performed in December 1995 due to poor weather. No significant differences were found between midwater fish abundance in the G-West area and Reference areas in 1994 and 1995 (Weimer *et al.*, 1996). Although few fish were caught in April and December 1996 in the midwater trawls, the dominant species represented was white perch. Blue back herring and alewife dominated the midwater trawls in June 1996 in G-West and areas A and B, whereas white perch dominated the catches in Area C (Brandt *et al.*,1996a). In October 1996, Bay anchovy and blueback herring were most abundant in the midwater trawls (Brandt *et al.*, 1996b).

Species diversity differed seasonally and among the years. Generally, the highest diversity for all areas, except Area C, was observed in 1993, with fewer species caught in subsequent years. In April and October 1996 at G-West, species diversity numbers approached those observed during the baseline period. However, any minor variations between yearly catches do not necessarily demonstrate a change in the diversity of a particular area (Weimer *et al.*, 1996).

In 1995, diel and seasonal differences in fish distributions were also observed. The proportion of striped bass caught in day versus night bottom trawls was approximately 2 to 1. In addition, almost twice as many white perch were caught in day versus night bottom trawls, whereas the ratio of hogchokers caught in night versus day bottom trawls was greater than 2 to 1. American eel were also far more common in the night versus day bottom trawls (Weimer *et al.*, 1996).



MARYLAND ENVIRONMENTAL SERVICE

PORT OF BALTIMORE MARYLAND PORT ADMINISTRATION

US Army Corps of Engineers

POOLES ISLAND
FISHERIES MONITORING AREAS
FIGURE 4–6

C:\HMI\NC\DRWG\040793.DWG

Sampling Season	Day Bottom Trawls # fish caught for all species				Night Bottom Trawls # fish caught for all species				Night Midwater Trawls # fish caught for all species				Day & Night Bottom Trawls # different species			
	G-West	Area A	Area B	Area C	G-West	Area A	Area B	Area C	G-West	Area A	Area B	Area C	G-West	Area A	Area B	Area C
April																
1993	195	211	323	--	379	117	566	--	--	49	82	--	10	8	7	--
1994	246	287	308	439	165	316	197	194	4	3	22	53	5	5	4	6
1995	255	254	350	1103	280	410	508	550	150	204	165	23	8	9	7	7
1996	590	704	1114	918	305	433	737	1021	1	3	4	50	7	6	7	6
June																
1993	981	706	233	--	1596	1439	750	--	2847	1605	1400	--	17	15	13	--
1994	485	510	444	1565	462	692	512	751	--	11	65	145	10	10	11	9
1995	289	293	125	777	520	175	81	463	49	40	189	133	9	8	8	6
1996	1242	1149	886	8463	1885	3662	710	5052	1250	1732	692	2604	9	9	11	6
October																
1993	4164	2264	820	--	1194	1727	3399	--	2425	3483	2777	--	14	14	16	--
1994	446	1380	655	11235	511	1395	5482	--	1678	4107	2664	--	11	16	14	11
1995	3332	2131	1135	2163	306	79	567	346	239	328	633	226	7	9	11	9
1996	2221	1266	359	1334	1334	5687	3934	2809	122	--	1934	--	13	14	12	15
December																
1992	5767	1294	891	--	1206	829	788	--	25	99	376	--	12	13	13	--
1994	321	1100	1127	636	648	1088	1514	1695	86	40	38	822	11	12	13	14
1995	--	701	--	112	--	--	--	--	--	--	--	--	--	9	--	5
1996	678	853	1665	1568	778	572	1201	875	22	75	3	0	8	8	10	7
Total													(Mean)	(Mean)	(Mean)	(Mean)
1993	11107	4475	2267	--	4375	4112	5503	--	5297	5236	4635	--	13	13	12	--
1994	1498	3277	2534	13875	1786	3491	7705	2640	1768	4161	2789	1020	9	11	11	10
1995	3876	3822	1660	4136	1106	664	1156	896	438	572	987	382	8	9	9	7
1996	4731	3972	4024	12283	4302	10354	6582	9757	1395	1810	2633	2654	9	9	10	9

Table 4-2: Summary Of Day & Night Bottom Trawls & Night Midwater Trawls - 1992/3, 1994, 1995, & 1996 (Weimer *et al.*, 1996; Brandt *et al.*, 1996a; Brandt *et al.*, 1996b; Brandt *et al.*, 1997)

Note: "--" denotes that data was unavailable for the specified sampling period.

Comparison of the Pooles Island area to Bay-wide fish abundance, size and species composition studies indicates that fish densities in the Pooles Island area are not considered exceptionally high when compared to points further south (Lou and Brandt, 1993; Weimer *et al.*, 1996). Differences in the data collected from G-West and the three reference areas suggests that natural inter-annual variability in the upper Bay can account for many of the differences observed between areas, seasons and years. Natural fluctuations in the reference areas, specifically Reference Area C which is located well outside the potential impact area from placement activities, support this conclusion (Weimer et al., 1996).

4.3.5.2.2.2. Gillnet Surveys

The midwater and bottom experimental trawl study provided estimates of both the abundance, size and species composition of midwater and bottom fish communities. However, constraints due to the size of trawl nets which are fishable in the Chesapeake Bay and due to the irregular bathymetry use of this gear results in a bias of the capture size toward the smaller fish as larger fish tend to evade the trawling gear. Thus, the experimental trawl data did not give reliable estimates of the abundance of larger individuals. To determine the abundance, size and species composition of individuals evading the experimental trawls, Miller and Sadler (1997) sampled the Pooles Island area employing experimental anchored gillnets that had a wide range of mesh sizes (3,4,5,6,7 and 8 inch).

The gillnet studies were conducted in G-East and Site 92 and reference areas A, B and C from July 8 to 10, October 7 to 11, and December 2 to 10, 1996 (Figure 4-6). These studies were conducted in the original G-East concept area that included the northeastern area of high relief. Additional gillnets were deployed in areas of high relief in G-East during each sampling period to investigate whether these localized higher relief areas provided unique habitat for fishes. Data analysis for July, October and December follows. For the gillnetting data analysis, CPUE was defined as catch per hour.

The primary species composition for the July sampling period was menhaden, striped bass, white perch and white catfish. The total catch of 1,497 fish was dominated by menhaden and catfish which together constituted 88% of the total catch for July. Striped bass represented 7.5% by number and 24% by weight. When compared to the reference areas and Site 92, G-East represented an intermediate CPUE for all species captured. Overall, little difference among species was noted in the original G-East area between the high relief areas and low relief areas. However, the high relief areas in G-East exhibited higher catch rates of small striped bass than the low relief areas during July. The original G-East concept area was reconfigured to exclude an area of high relief in the northeastern portion of the site based upon results of the angling study (Section 4.5.3.1). This northeastern area of high relief was found to be a productive fishing area for striped bass. The gillnetting data for July supported this conclusion. In July, the CPUE for striped bass, measured in catch/hour, for each of the sample areas was: G-East - 0.166; Site 92 (Area A) - 0.137; Area B - 0.526; and Area C - 0.404 (Miller and Sadler, 1997). In July, gillnets were set in the overlap area between Site 92 and Area A. Therefore, this data could be used to characterize either area. However, as this overlap area was considered as representing Site 92 in subsequent events, for consistency it will be used to characterize Site 92 during the July event.

In addition to the primary species captured during July, weakfish and gizzard shad were also captured in October. However, the number of fish caught (451) during this period was roughly one third the amount captured in July (1,497). The October catch was dominated by menhaden and gizzard shad, which represented 80% of the catch by number and 74% of the catch by weight. In comparison, striped bass constituted 8% of the cat h by number and 26% of the catch by weight. Differences in CPUE between the four regions was examined and no consistent patterns in mean sizes for the dominant species among the regions was found. The CPUE for striped bass, measured in catch/hour, for each area was: G-East - 0.007; Site 92 - 0.200; Area A - 0.080; and Area B - 0.032. Gillnet data were not collected in Area C due to sampling difficulties. Overall, Site 92 had the highest CPUE for striped bass, as well as gizzard shad and menhaden. G-East had the lowest CPUE for striped bass, gizzard shad and menhaden. The low number of fish caught in October prevented comparison of areas of high and low relief in G-East.

Catch data in December appeared to contrast with data from the previous sampling periods, particularly in terms of dominant species. The primary species composition was striped bass and white perch, which represented 90% of the total catch. Striped bass represented 55% by number and 84% by weight of the total catch. Menhaden, which were present during both July and October sampling periods, were completely absent from the December sampling. The total catch of 195 fish was the lowest recorded of all three sample periods; it was less than half of the total catch during October and only 13% of the total catch in July. The CPUE for striped bass, measured in catch/hour, for each area was: G-East - 0.093; Site 92 - 0.009; Area A - 0.019; Area B - 0.068; and Area C - 0.122. Striped bass captured during the December sampling period were 280 to 665 mm in length, which was similar to the size range observed in July (252 to 730 mm) and October (293 to 648 mm). Furthermore, no relief dependent or regional dependent differences were noted for the Pooles Island area during the December sampling period.

Over all three periods combined, menhaden dominated the catches representing 61% of all fish caught by number. Catfish were the next most numerically dominant species representing over 21% of the total catch, followed by striped bass representing 11% of the total catch. Upon completion of the third sampling period, Miller and Sadler (1997) were able to determine several patterns in fisheries usage of the areas.

The first pattern indicated that fish species in the Pooles Island vicinity occupy the area differently on a seasonal basis. Menhaden appeared to use the area only during the summer and autumn months, and grew little while in the area. The second pattern, characterized by catfish, white perch and to a lesser extent gizzard shad, indicated that the area is used by a single cohort, that grows while present in the area. The last pattern, characterized by striped bass, was one of consistent, broad usage throughout the year. Patterns of fish use in the Pooles Island area for all three sampling periods indicated that relief or region did not consistently effect where the fish were captured in this study.

Results of Miller and Sadler's research (1997) suggested that there was no evidence of unique characteristics in either G-East or Site 92; they were similar to the reference areas in species composition and age distribution.

4.3.6. Waterfowl and Colonial Wading Birds

Waterfowl in the Chesapeake Bay region are an important economic and recreational resource and important to the ecology and heritage of the Bay region. Waterfowl hunting continues to provide, as it has in the past, a recreational resource for both local and international sportsmen. Waterfowl play an important part in the trophic structure and balance of macroinvertebrates and aquatic vegetation in the Bay region. Nine species of waterfowl were targeted for discussion. The species were chosen due to their role in Maryland recreational resources, their ecological importance, and their potential sensitivity during the dredged material operations window. The targeted species are: American Black Duck (*Anas rubripes*), Canada Goose (*Branta canadensis*), Canvasback (*Athya valisineria*), Greater Scaup (*Aytha marila*), Lesser Scaup (*Aytha affinis*), Mallard (*Anas platyrhynchos*), Red Breasted Merganser (*Mergus serrator*), Tundra Swan (*Cygnus columbianus*) and Wood Duck (*Aix sponsa*).

The Pooles Island area is frequented by all of the aforementioned waterfowl species in addition to the following colonial wading bird species: Great Blue Heron (*Ardea heroldias*), egrets (*Casmerodius spp.*), Little Blue Heron and Black-crowned night heron (*Nycticorax nycticorax*). Appendix B presents information on migratory patterns, habitat, and reproductive requirements for each of the waterfowl and colonial wading bird species.

The MDNR Wildlife and Heritage Division (WHD) reported that Pooles Island is the site of a very large Great Blue Heron colony (Appendix A, WHD ltrs, July 23, 1996 and Dec. 9, 1996). The Great Blue Heron is not considered a threatened or endangered species, but is protected under the Non-game and Endangered Species Conservation Act (COMAR 08.03.08.04) (Mike Slattery, MDNR, Pers. comm., January 30, 1997). No impacts to the Great Blue Heron colony have been observed from previous placement actions in the Pooles Island area.

4.3.7. Raptors

There are two species of raptor in the upper Bay which were targeted for discussion, the Osprey (*Pandion haliaetus*) and the Bald Eagle (*Haliaeetus leucocephalus*). There is a known Bald Eagle nest located on the southern end of Pooles Island. In addition to the Bald Eagle nest site, Pooles Island currently supports approximately 10 Osprey nest sites which are located on or directly around the island (Jim Potty, pers. comm., Nov. 14, 1996). Although the Bald Eagle and Osprey nesting sites are within a ½ mile of the proposed placement sites, no impacts to these nesting sites have been observed as a result of previous placement actions in the Pooles Island area. Appendix B presents detailed information on each of the raptor species habitat and reproductive requirements of these raptor species.

4.3.8. Threatened and Endangered Species

Endangered species are those species listed whose prospects for survival are in immediate danger due to loss or change of habitat, over-exploitation, predation, competition, or disease. Threatened species are those which may become endangered should conditions surrounding the species begin or continue to deteriorate. Species may be classified as endangered or threatened on a Federal or State basis (PCOE, 1996). In accordance with Section 7 of the Endangered Species Act (ESA) (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*, MES requested information on the presence of species which are listed or proposed for listing as rare, threatened or endangered in the project area from the MDNR Wildlife and Heritage Division (WHD) and the US Fish and Wildlife Service (USFWS).

The WHD reported that no records of Federal or State rare, threatened or endangered plants or animals were recorded within proposed placement areas G-East and Site 92 (Appendix A, WHD ltrs, July 23, 1996 and December 9, 1996). The WHD also compiles data concerning threatened and endangered species in Maryland on a county by county basis. Pooles Island lies within the Harford County boundary, for which a list of current and historic, rare, threatened, and endangered species has been compiled. This compilation of species is included in Appendix A.

The USFWS stated that except for occasional transient individuals, no other Federally listed or proposed for listing endangered or threatened species under their regulatory jurisdiction were known to exist in the proposed placement areas (USFWS ltrs, July 22, 1996 and November 26, 1996). The shortnose sturgeon, an endangered species under the purview of the Department of Commerce, National Marine Fisheries Service (NMFS) occasionally has been found in the Elk River/upper Chesapeake Bay area. The migration route to this area may well be the C&D Canal and Delaware River. A coordination letter was received from NMFS regarding this species (Appendix A). NMFS could not comment on the status of the shortnose sturgeon in the Bay at this time and is encouraging further study. Section 7 consultation is on going with NMFS and will be finalized prior to implementation of any placement actions.

4.4. CULTURAL RESOURCES

In preparing this Draft EA, the PCOE consulted with the Maryland Historical Trust (MHT) and other interested parties to identify and evaluate historic properties as designated by the National Historic Preservation Act of 1966, as amended, and its implementing regulations, 36 CFR Part 800. As part of this work, a cultural resources investigation was conducted in the G-East and Site 92 areas. The study findings are presented in a draft report entitled "A Phase I Submerged Cultural Resources Investigation, Upper Chesapeake Bay, Maryland (G-East Disposal Site and Disposal Site #92)" (Dolan Research and Hunter Research, 1996). Researchers identified two submerged targets exhibiting shipwreck characteristics. One is in Site 92 and one is in an area immediately adjacent to the original G-East. Section 106 consultation with the MHT is ongoing and will be finalized prior to the implementation of any project actions. The following brief narrative has been summarized from reports prepared by Ocean Surveys, Inc. (1993) and from Dolan Research, Inc. and Hunter Research, Inc. (1996).

4.4.1. Maritime History of the Upper Bay

Historic maritime activity across all portions of the Chesapeake Bay dates to the end of the sixteenth century. The first organized European settlement in Maryland was established at St. Mary's City in 1634. When the first parliament of Maryland was assembled in 1649, there were only two permanent settlements in the Bay region; St. Mary's on the western shore and Kent Island on the eastern shore. The Maryland General Assembly enacted legislation for the formation of numerous communities with the town acts of 1675, 1683, 1706, 1707 and 1719. The Act of 1706 designated forty-two town locations including six as ports of entry for the colony: Chestertown, Annapolis, St. Mary's, Green Hill, Oxford and a site on Beckwith's Island. All foreign goods shipped to Maryland were to pass through one of these ports. The supplementary act of 1707 required that all merchandise for export, except "timber pipe, stave billetts, and wooden ware," were to be first brought to one of the six official ports. The 1707 legislation empowered town commissioners to establish public landings.

During the eighteenth century, the Bay region's agricultural production began to shift away from tobacco cultivation. A major move towards grain production ultimately reduced traditional trade with England. A strong eastern shore export trade to the West Indies was established at Chestertown and later at the rapidly expanding port of Baltimore. Baltimore continued to grow in importance, supplanting Annapolis as the primary port of the upper Bay.

The upper Bay hosted extensive steamboat activity during the nineteenth century. Baltimore's first steamboat, the Chesapeake, was built in 1813. Between 1831 and 1843, Baltimore served as the home for ten different steamboat companies. Much of the nineteenth century transportation activity on the upper Bay was geared toward the fin and shellfishing industry. Several types of sailing boats were employed throughout the first half of the twentieth century to harvest oysters, clams and crabs. Schooners, log canoes, sloops, bugeyes, skipjacks and pungies were all different types of sailing rigs utilized on the Bay.

4.4.2. Documented Shipwreck Losses

The MHT shipwreck and submerged obstructions data list was referenced for the Pooles Island area. Twelve documented shipwrecks and eleven obstructions were listed. The shipwrecks include the Industry (1753), Hawke (1766), Henry (1772), Pennsylvania (1875), Alice (1881), Antares (1931), John C. Baxter (1935), Maguire (1944), Howard Wood (1944), Hughes Bros (1946), Cohasset (1948) and Weezie (1972). There are no known submerged sites in the G-East and Site 92 project areas that are listed on the National Register of Historic Places.

4.4.3. Previous Cultural Resources Investigations

Several remote sensing cultural resource investigations have been conducted in the immediate project vicinity. Phase I investigations, including ground truthing of high probability targets, was completed for the proposed G-West placement area in 1993 (Ocean Surveys, 1993). No targets where located that were considered significant cultural resources. Appropriate coordination was completed with the MHT and placement was begun in Area G-West in 1993. Phase I and Phase II studies were completed in preparation for proposed work in the C&D Canal northern approach channels, including a preliminary archaeological evaluation of the general vicinity encompassing the G-East and Site 92 project areas (R. Christopher Goodwin and Associates, 1995a/b; Tidewater Atlantic Research, 1996). Remote sensing investigations in the original G-East and in the reconfigured Site 92 located two targets exhibiting shipwreck characteristics (Dolan Research and Hunter Research, 1996). Further investigation and coordination with the MHT is ongoing.

4.5. SOCIOECONOMIC FACTORS

4.5.1. Identification of Socioeconomic Factors

Pooles Island is an uninhabited island that is located within the APG Restricted Area. Access to Pooles Island and the water area within the defined and charted restricted area is under the jurisdiction of the U.S. Army and recreational boating use of the water area within the APG-controlled area is restricted. Except for historic property preservation activities associated with the old lighthouse on the northwest corner of Pooles Island, public access is prohibited. G-East and Site 92 are located over 2 miles from the nearest populated areas on the western and eastern shores of the Chesapeake Bay. Therefore, potential aesthetic, noise and air quality effects of placement of dredged material are minimal. In regard to water quality, the Pooles Island area is located in the "turbidity maximum zone" of the Bay. Therefore, the area is naturally turbid. Water quality factors are discussed in detail in Section 4.3.1.

Participants in the Upper Bay Working Group, specifically resource agencies and the local charter boat industry whose captains operate in the upper Bay, expressed concern that use of the proposed G-East placement site might negatively affect the recreational fishery in the Pooles Island area. They stated that use of this site would reduce the abundance or catch rates of large migrating fish which are typically the target of the recreational and commercial fisheries. Specifically, portions of the proposed G-East placement site, as originally configured, were stated to be important for maintaining the health and profitability of the local charter boat industry (Upper Bay Working Group Meeting Minutes, May 6, 1996). The large migrating species that are targeted by the upper Bay commercial and recreational fishing interests are striped bass, bluefish and weakfish (Miller, UMCEES, pers. comm., Jan. 1997). The charter boat captains also stated objections to any open-water placement activities in the Pooles Island area (Upper Bay Working Group Meeting Minutes, February 5, 1997). Representatives of the Maryland Saltwater Sportfishermen's Association (MSSA) contacted by MES during preparation of this EA expressed concerns similar to those of the charter boat captains with respect to the use of the Pooles Island area for the placement of dredged material (MSSA, pers. comm., Oct. 15, 1996). As a result of these concerns, fishing activity in the Pooles Island area was identified as a factor which warranted specific examination in this EA.

Early in the working group process, representatives of the charter boat captains stated that the northern portion of the original G-East site configuration was characterized by regions of high vertical relief which they considered to be important fishing locations. Resource agency representatives advised that high relief areas are traditionally considered to be important fisheries habitat. Bathymetric studies completed for this EA confirmed that the northeastern portion of the original G-East site configuration was characterized by regions of high relief. Results of the angling survey performed for this EA (Section 4.5.4) provided information to support the anecdotal reports from the charter boat captains that this specific area of high relief was productive for striped bass fishing. Based on results of the angling survey, this area of high relief was excluded from the proposed G-East placement area.

The high relief in the northeastern portion of the original G-East site configuration is currently used for shell excavation by the MDNR in support of the oyster reef recovery program and is permitted by the MDE and the CENAB. Shell dredging activities are required to leave edges between the shell dredge channels following excavation. This has in fact, formed some of the observed high relief areas in this area. Effects on fishing activity are not documented, although the EA performed for the shell dredge operations found short term, near field impacts to fish abundance from the shell dredge activities (MDNR, 1987). Discussion with several charter boat captains indicated that once an area is mined for oyster shell, it takes several years before it is suitable for charter boat fishing (Thomas, Upper Bay Charter Boat Captains Association (UBCBCA), pers. comm., 1996).

4.5.2. Charter Boat Industry

The charter boat industry in the upper Bay consists of individual boats which operate from both the eastern and western shore. Information about charter boat economic activity was developed through discussions by the MES staff with charter boat captains during the performance of the charter boat angling survey.

Approximately eight charter boats operate in the northern portion of the upper Bay which includes the Pooles Island area. These eight boats regularly use the Pooles Island area during striped bass fishing seasons and would potentially be affected by dredged material placement activity. One head boat also operates in the upper Bay.

The charter boat fleet that operates in the Pooles Island area consists of individually owned boats that range from about 28 feet to about 50 feet in length. The operators of all these vessels except for the head boat are licensed by the Coast Guard to carry no more than 6 passengers for hire. Most of the boats operate from locations in northeastern Baltimore County and are only used seasonally for striped bass fishing, although, when striped bass are not in season, several operators occasionally take parties for other species such as perch. Some of the charter boat captains operate their boats from Chesapeake Beach or Crisfield, Maryland, during the spring striped bass season. With several exceptions, the charter boat fleet that uses the Pooles Island area provides supplemental or secondary incomes for the boat captains. Economic productivity of the charter boats that used the Pooles Island area varies annually by the number of boats and charters. Specific economic data were not available.

According to interviews with the charter boat captains, fishing activity by the Baltimore County-based charter fleet, when operating from Baltimore County locations, ranges as far north as Shad Battery Shoal and as far south as the Chester River (Young, MES, pers. comm., 1997). However, most of the fishing activity is conducted in the portion of the upper Bay north of Swan Point and Hart-Miller Island and south of Worton Point, with considerable use of the areas that were included in the charter boat angling study. The charter boat captains do not use the Pooles Island area exclusively, but vary their fishing activity based on prevailing conditions. Most of the shoals that are fished (i.e., areas of high relief) were anecdotally reported to be productive during strong ebb tide current conditions. Some shoals were reported to have their best productivity during strong flood tide current conditions. A few shoal areas were reported to be productive during both flood and ebb tide current conditions. The expected current condition was identified as a principal, although by no means exclusive, factor that is used in estimating which area would be most likely to produce fish on any given day. Actual fishing activity varies accordingly.

4.5.3. Fishing Activity Studies

One field study and three data assessments were conducted in order to characterize the fishing activity in the Pooles Island area and to address the concerns expressed by resource agency representatives and charter boat captains who participated in the Upper Bay Working Group and by representatives of the MSSA. The field study was a fishery-independent assessment, a striped bass angling experiment, to assess the importance of commercial and recreational fishing activity in the Pooles Island area, outside of the APG Restricted Area. The study employed charter boats and volunteer fishers because it was thought that this approach would benefit from the charter boat captains expert local knowledge of the recreational fishery and would yield the most consistent and relevant results. The data that were collected, in combination with the data assessment studies, provided a characterization of fishing productivity of G-East and Site 92.

The first data assessment involved analysis of on-site intercept data previously collected by the NMFS for that agency's Marine Recreational Fisheries Statistical Survey (MRFSS). The MRFSS survey data involved interviewing the fishers at their access points (e.g., marinas, boat ramps) to the upper Bay. The second data assessment used data reported by commercial fishermen and charter boat captains to the MDNR to characterize the recreational and commercial fishery. The third data assessment analyzed aerial survey data collected by the MDNR. These data provided estimates of the distribution of fishing effort in much of the upper Bay.

The charter boat angling study found that fishing productivity of striped bass in the original G-East site configuration was concentrated in an area of high relief on the northeastern edge of the site. This concentration of catch in the high relief area resulted in this specific area being considered important locally for fishing, so this area was removed from consideration. Although the results of the angling study found the area of high relief that was in the original G-East site configuration to be the most productive striped bass fishing area within the proposed site, the overall results of the study resulted in a CPUE in the proposed G-East and Site 92 placement sites that was lower than that of the reference areas. Combined with the other three assessments, the data indicated that the Pooles

Island area did not appear to uniquely contribute to the overall charter boat and commercial fishing activity of the upper Bay, although certain portions of the Pooles Island area were locally considered important for recreational fishing activity.

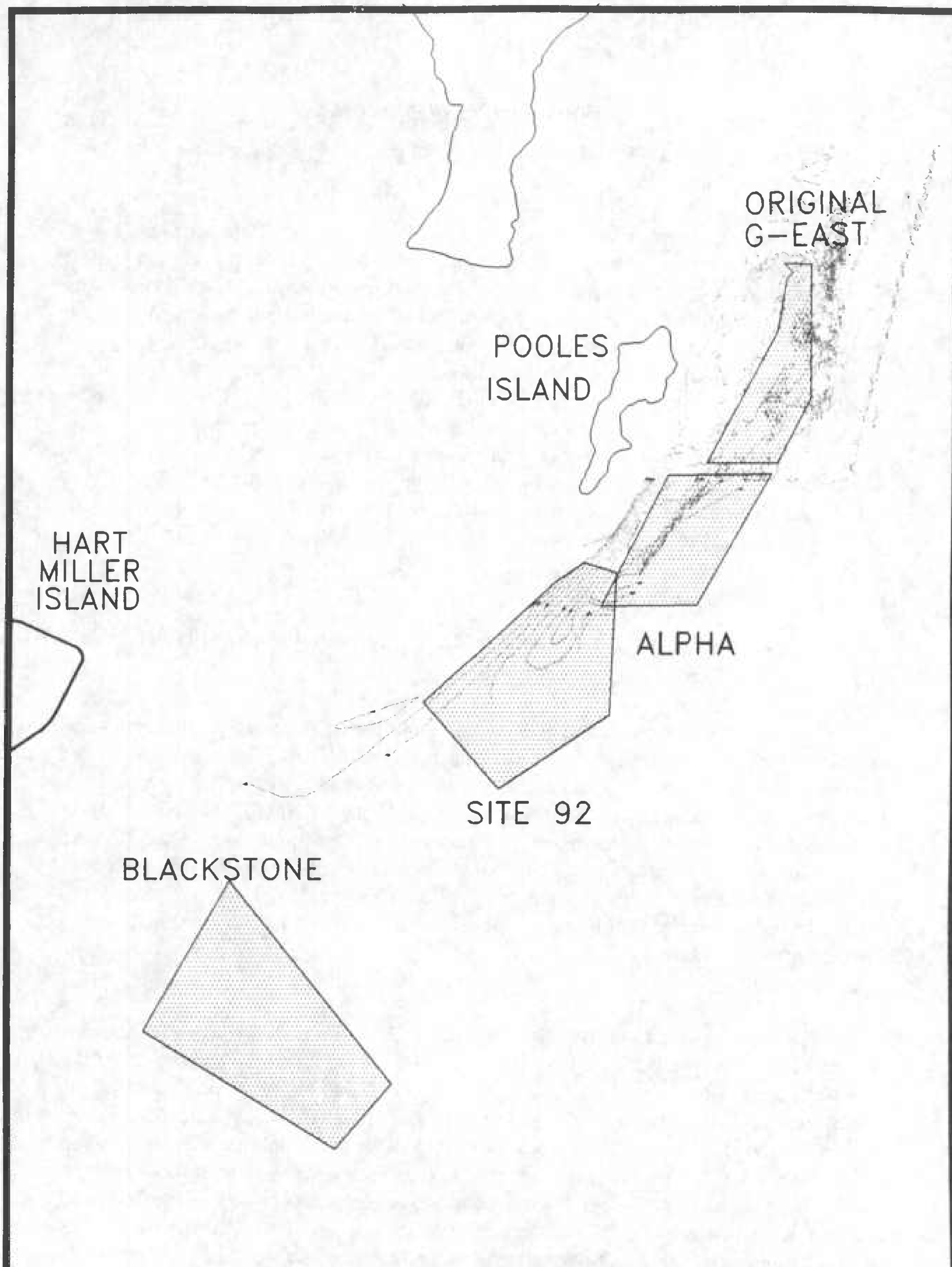
4.5.3.1. Charter Boat Angling Study

This study was developed by MPA, PCOE, MES and UMCEES in consultation with charter boat captains who regularly fish the Pooles Island area during striped bass seasons. The charter boat captains advised that the shoals (i.e., area of high relief) in the northeastern portion of the original G-East site configuration were particularly productive during strong ebb tide current conditions (Young, MES, pers. comm., 1997).

The UMCEES designed, and MES conducted, the field study to provide estimates of the fishing productivity of proposed G-East site and Site 92 in comparison with reference areas in the Pooles Island area (Miller and McCracken, 1997). The field study was a striped bass catch and release angling experiment involving charter boat captains who operate from northeastern Baltimore County. The study also used volunteers who fished using standard striped bass angling techniques under the instruction and guidance of the charter boat captains. MES staff members coordinated the fishing activity and gathered data on length and species composition. Supplemental data were also collected regarding location of strikes and catches and time of catch, thereby enabling correlation of data with the location of high relief and predicted current conditions. The angling experiment was conducted on 16 non-consecutive days during the period of August 24, 1996, through October 30, 1996. The study period overlapped with the majority of the Maryland striped bass Fall recreational fishery season. In addition to the two proposed placement sites (G-East and Site 92), two reference areas (Alpha and Blackstone) were fished during the angling experiment (Figure 4-7). Each of the four data collection areas were fished concurrently by different boats during the same tidal cycle using the same gear, bait and fishing technique.

The UMCEES analyzed the data that were collected and reported that the CPUE (fish per fisher per hour) in each area of the striped bass angling survey were as follows:

Data Collection Area	CPUE
Alpha	0.365
Blackstone	0.357
G-East (original site configuration)	0.148
Site 92 (expanded site configuration)	0.0193



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MARYLAND ENVIRONMENTAL SERVICE

PORT OF BALTIMORE 1706

MARYLAND PORT ADMINISTRATION

US Army Corps of Engineers

CHARTER BOAT
ANGLING SURVEY AREAS
FIGURE 4-7

The CPUE at Alpha was 19 times greater than the CPUE of Site 92 and 2 times greater than the CPUE at G-East (original site configuration). The CPUE at Alpha was similar to that at Blackstone.

The spatial distribution of catches in each of the data collection areas was examined in order to assess the catch patterns in more detail. Within the original G-East site configuration, 84% of the total striped bass catch was from an area of high relief in the northeastern portion of the site. As a result of this study, the northeastern portion of the site was excluded from the proposed placement area. During the study, productivity was concentrated in certain portions of some, but not all, areas characterized by high relief. This finding suggested that the interaction of the high relief with the ambient environment created localized conditions that on some days were very favorable to striped bass feeding. This result was consistent with anecdotal observations reported to the MES staff by charter boat captains. However, even for the most productive locations, there was substantial variability in fishing productivity daily and over the entire study period, attributable, at least in part, to highly variable natural conditions which affect the study areas.

4.5.3.2. NMFS Marine Recreational Fisheries Statistical Survey

This data assessment study, performed by the UMCEES, involved interpretation of charter boat and private fishing vessel data from the Marine Recreational Fisheries Statistical Survey (MRFSS) conducted in the Maryland waters of the Chesapeake Bay. Data covering the period of 1985-1995 was obtained from the NMFS Statistics Division to report fishing activity in the upper Bay and Pooles Island area. Over the 10 year period analyzed, 58 different sites contributed to estimates of CPUE for the upper Bay and Pooles Island area, with an average of 16 sites per year. The access sites were located in Anne Arundel, Baltimore, Cecil, Harford, Kent and Queen Anne's Counties (Miller and McCracken, 1997).

A weighting scheme was designed by UMCEES to estimate the probability that catches came from the Pooles Island area. The CPUE was weighted according to the inverse of the shortest navigable distance from access points to the Pooles Island Light. For example, the distance from Rock Hall to Pooles Island Light was calculated as the shortest navigable distance from Rock Hall, around Swan Point, to the Light. The shortest navigable distances were assigned a scaling factor that was used to weight the data. This weighting scheme gave more weight to access points closest to Pooles Island and less weight to those furthest away. The weighted CPUE was calculated for this study by multiplying the catch rate (number of fish hooked and released per person per trip) by the appropriate weighting scale (divider). For this study, the catch was defined as the hooked and released catch only. This represented 94% of the total catch (Miller and McCracken, 1997). The remainder of the total catch was the harvested fish which provided a minimal contribution to the total catch.

Annual CPUE's for the Maryland portion of the Chesapeake Bay, the upper Bay and Pooles Island (weighted estimates) for all species combined were calculated. When evaluating the CPUE's for all species, no clear trend was observed for any region. Over the period analyzed, the average weighted CPUE for the Pooles Island area for all species combined was 0.077 fish/fisher/trip. The fact that the weighted CPUE for the Pooles Island area was much lower than the CPUE for the upper Bay (0.989 fish/fisher/trip), even though the Pooles Island CPUE was a simple weighted combination of values for the upper Bay, indicated that most of the catch in the upper Bay was coming from access points some distance from Pooles Island. Thus it was concluded that the likelihood of activity in the vicinity of Pooles Island impacting the overall CPUE of the upper Bay is small.

Estimates of weighted CPUE for the dominant fish species gathered for the Pooles Island area for the ten year period, based on hooked and released catch only, was 0.059 fish/person/trip for striped bass, 0.234 fish/person/trip for white perch, 0.082 fish/person/trip for spot, 0.019 fish/person/trip for croaker, and 0.088 fish/person/trip for channel catfish. Average trips for this analysis were 4-6 hours (Miller, UMCEES, pers. comm., 1997). There was a general increasing trend in weighted striped bass CPUE for the Pooles Island area over the ten year period which is unlikely to reflect local conditions; rather it reflects the gradual recovery of striped bass throughout the Chesapeake Bay. The upper Bay and Maryland striped bass CPUE exhibited a general increasing trend over the ten year period (Miller and McCracken, 1997).

The majority of intercepts in the MRFSS database came from private or rental boats. Few charter boat parties were intercepted. To fully characterize the activity in the charter boat fishery, the log book entries reported to MDNR by the charter boat captains were analyzed. This information is presented below.

4.5.3.3. MDNR Database: Charter Boat and Commercial

The second data assessment was performed by the UMCEES to further analyze the patterns of charter boat fishing activity in the Pooles Island area and to address commercial fishing activity (Miller and McCracken, 1997). To complete this study, data was obtained from MDNR for the period 1993-1996. The study was restricted to data from 1993 to 1996 because this was the only time period that access point data was available. The weighting scheme for this data assessment study utilized dividers to quantify the probability that the reported landings came from the Pooles Island area. Dividers were incremental rings that originated from the Pooles Island Light and expanded outward (similar to a bulls-eye) until they encompassed the furthest home addresses of the fishers. Each of the dividers was assigned a scaling factor that was used to weight the data. The CPUE for charter boat catch was calculated based on number of fish caught, whereas the CPUE for commercial catch was calculated based on the total weight of fish caught.

Data collected for hooked and released fish species in the Pooles Island area were used to estimate the charter boat catch for this study. The overall weighted striped bass CPUE for the Pooles Island area, when expressed as fish per trip, was 0.556. The overall estimated weighted striped bass CPUE for the Pooles Island area, when expressed as fish per fisher per trip, was 0.08; the fisher was defined as 7, representing the average number of fishers per trip. The weighted charter boat CPUE of striped bass, bluefish, croaker and weakfish in the Pooles Island area remained stable over the four years. The weighted CPUE of catfish and spot exhibited increasing trends in 1993 and 1994, however, they exhibited inverse trends in 1995 and 1996. In general, the weighted CPUE of white perch was higher than all other species. The catch rates for striped bass and white perch in the Pooles Island area were below those derived from all of MD NOAA Code 025; data was unavailable for bluefish, croaker, catfish, weakfish and spot.

Results of the commercial fishing portion of the study indicated that no fixed (*i.e.* pound net) gear was used in the commercial fishery around Pooles Island. Commercial fishing activity primarily involves fish pots and drift gillnetting. Fish pots are sometimes placed in the vicinity of Pooles Island, while drift gillnets are set primarily in the channel immediately to the east of G-East during the winter striped bass commercial season. The study was restricted to data from the winter of 1994/1995 through to the winter of 1996/1997 because the fisher's home address was only available for this time period. This address data was necessary for the weighting scheme. For this period the weighted commercial CPUE for the Pooles Island area was 484 pounds/hour for gear types combined, compared to the CPUE for the entire MD NOAA Code 025 area which was 5,856 pounds/hour for gear types combined. For all species reviewed, which included striped bass, white perch, spot, weakfish, American eel and catfish, the CPUE in the Pooles Island area was less than one-tenth the CPUE for the entire MD NOAA Code 025 area.

4.5.3.4. Aerial Survey

In 1992, the MDNR performed an aerial survey during the Fall striped bass sport fishing open season (Oct 1-31, and Nov 7, 1992) (MDNR, 1994). A total of nine flights were flown during this aerial survey. One flight was flown during the week and one during the weekend throughout each week of October; the ninth flight occurred on Nov. 7, 1992. A total of 8 cross-Bay transects (between the eastern and western shores) and one short transect paralleling the eastern shore (from Fairlee Creek to Still

Pond) were flown on each sampling day. Transects began as far south as the Choptank River and extended north to just below Pooles Island.

Transects 8 and 9, which are the furthest north transects located just below Pooles Island and the short eastern shore transect from Fairlee Creek to Still Pond, respectively, were used to characterize fishing activity in the Pooles Island area. Fishing activity in the Pooles Island area represented 15.8% of the total fishing activity throughout the entire sampling area which included portions of the mid-Bay. By ranking the 9 transects according to percentage by transect, the two transects in the Pooles Island area were ranked sixth and seventh (MDNR, 1994). During the survey, the greatest amount of fishing activity in the Pooles Island area (Transects 8 and 9) was observed during the first two weeks of October. There were no general trends exhibited between transects and the fishing activity appeared to fluctuate throughout the sampling region. Transect data did not distinguish between fishing activity in shallow areas immediately off-shore and in the mainstem area of the Bay. Thus, conclusions based on the data for the two transects in the Pooles Island area do not distinguish between recreational and commercial activity isolated to the immediate vicinity of Pooles Island and activity throughout the transect areas.

5. IMPACTS OF THE PROPOSED ACTION

Section 4 of this document enumerated the existing environmental and economic conditions in the areas of the proposed action. Economic impacts associated with the no-action alternative are outlined in detail in Section 1. No significant long-term environmental impacts are anticipated to occur as a result of the use of G-East and Site 92 for dredged material placement. This section will detail the specific environmental issues associated with the Pooles Island area as well as Bay-wide concerns and the analysis of these parameters relative to the use of G-East and Site 92 for dredged material placement.

5.1. HYDRODYNAMIC IMPACTS

Hydrodynamic impacts associated with utilizing open-water placement sites in the upper Bay are of concern due to the complexity of the Bay's hydrodynamics and its role in affecting water quality and living resources. The influences of wind, the C&D Canal, the Susquehanna River and other tributaries to the upper Bay interact with the astronomical tides and currents, and result in complex estuarine circulation with gradients of salinity, temperature and other water quality parameters which vary both spatially and temporally. These are constantly fluctuating because of issues related to the shallowness of the area, the fetch and the influence of wind on the water column. In the Pooles Island area, due to the aforementioned issues, bottom sediment resuspension and erosion are also influenced by the complex estuarine circulation.

Hydrodynamic
WES Model

Potential impacts to hydrodynamics of the Pooles Island area which would result from placement activities in G-East and Site 92 have been evaluated by the PCOE and the U.S. Army Corps of Engineers Waterways Experiment Station (WES). WES investigated the hydrodynamics of the area by utilizing a model to determine existing conditions, and to then evaluate potential effects of dredged material placement on the hydrodynamics of the Pooles Island area. The intent of the modeling study was to determine if detectable changes in flow direction and velocity would be induced by dredged material placement in G-East and Site 92. The model results presented here reflect the use of the reconfigured Site 92 and G-East areas. The information presented in the draft EA utilized the original configurations of both sites. The following discussion outlines the modeling procedures and results obtained.

5.1.1. Description of Hydrodynamic Modeling

WES utilized the hydrodynamic model RMA-2 for this investigation. RMA-2 is a component of the TABS-2 modeling system developed by the Hydraulics Laboratory at WES for two-dimensional hydrodynamic simulation of open channel flow, transport processes and sedimentation in rivers, reservoirs, bays and estuaries. The model uses a finite element solution of the Reynolds form of the Navier-Stokes equation for turbulent flows in two dimensions (vertical averaging) to compute water surface elevations and horizontal velocity components for subcritical, free-surface flow. Eddy viscosity coefficients are used to determine turbulent exchange. Friction is calculated with Manning's equation. Side boundaries are treated either as slip (parallel) or static (zero flow). The model also recognizes computationally wet or dry elements and corrects the mesh accordingly. Boundary conditions may be defined as combinations of velocity, water surface elevation, or discharge time series. RMA-2 provides a solution file, containing velocities and other data that can be displayed by FastTABS, a pre- and post-processor for 2-D finite element models (FastTABS Manual, 1996).

Two conditions were compared to determine if changes in flow and circulation result from the proposed dredged material placement. The "base" (existing) condition was defined by utilizing an existing WES model of the upper Bay, which was updated with recent MGS bathymetric data for the G-East and Site 92 study areas (see Section 3.1 for existing bathymetry). Figure 5-1 shows the model limits and mesh used for the base condition. Note the high mesh density to the east and south of Pooles Island shown in Figure 5.2, which reflects the recent bathymetric data for Site 92 and G-East obtained from MGS. The "plan" (proposed) condition consisted of the base condition bathymetry modified to reflect proposed dredged material placement in G-East and Site 92.

The model was run with the selected configurations of G-East and Site 92 as depicted in plan-view on Figure 5-2. The node numbers (1 through 10) indicated on Figure 5-2 are the locations of model nodes at which data on flow velocity and water level were saved for analysis, and are discussed later in this section of the report. G-East included a total surface area of 281 acres, and Site 92 included a total surface area of 934 acres. For the "plan" condition, the "base" bathymetry at G-East was modified by raising the existing elevation of the bottom to -16 ft MLLW, and the Site 92 bathymetry to -14 ft MLLW, consistent with the recommended final post-placement bathymetry at each site. Placement of dredged material to these elevations is based on tying into existing contours to create a level versus a mounded placement scenario.

Figure 5-1: Pre-existing Mesh for Upper Chesapeake Bay Utilized for Modeling

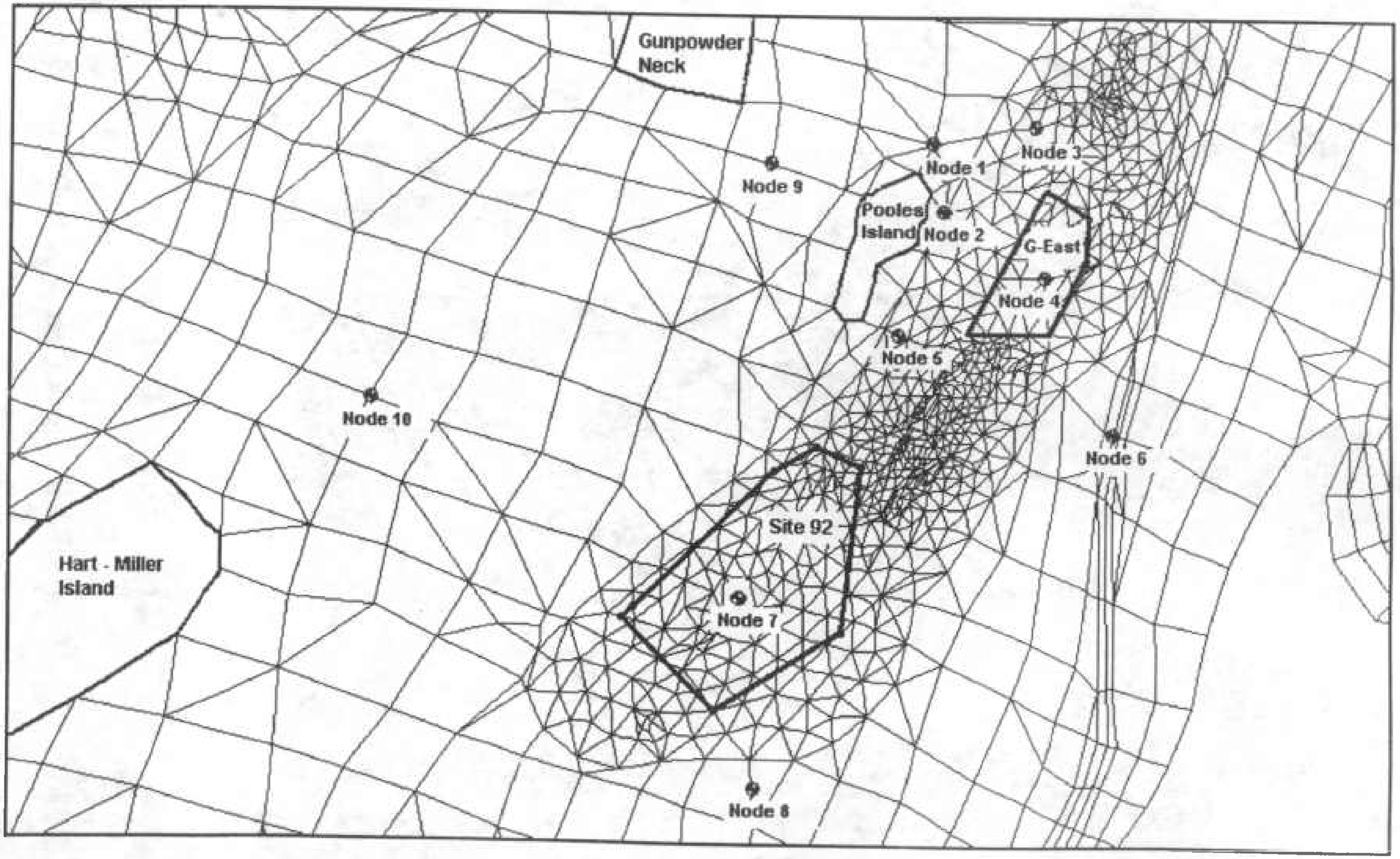


Figure 5-2: Location of G-East & Site 92 & Comparison Gauge Nodes

5.1.1.1. Mesh Design

The numerical modeling effort began with an initial mesh developed at WES to address other 2-D hydrodynamic problems in the upper Bay (Webb *et al.*, in prep.) A detailed submesh covering the Site 92 and G-East study area was created and refined with the Department of Defense Groundwater Modeling System (GMS), a comprehensive graphical-user environment for performing groundwater simulations (GMS Manual, 1995). Bathymetric data incorporated in the submesh for the study area were obtained from MGS (Panageotou *et al.*, 1996). Higher spatial resolution in the study area submesh was adopted to improve the model's ability to detect impacts from the proposed placement plans, and to more accurately depict the complex bathymetry of areas in and adjacent to the proposed placement sites. The submesh containing the study area was inserted and merged into the surrounding initial upper Bay mesh using FastTABS.

5.1.1.1.1. Base (Existing) Condition

The base condition mesh included bathymetric data obtained from National Oceanic and Atmospheric Administration (NOAA) charts and from data for the study area provided by MGS. The base condition mesh thus provided an accurate depiction of the present bathymetry of the study area and surrounding portions of upper Chesapeake Bay.

5.1.1.1.2. Plan (Proposed) Condition

The plan condition consisted of the base condition with modified bathymetry in the study area. The area within the boundaries of G-East was modified to bring depths to an idealized uniform -16 ft MLLW, and in Site 92, depths were modified to an idealized uniform -14 ft MLLW, consistent with the selected placement plan. Placement of dredged material to these elevations is based on tying into existing contours to create a level versus a mounded placement scenario.

5.1.1.2. Boundary Conditions

Boundary conditions utilized for modeling the base and the plan conditions included both tidal and historical flow boundary conditions. The downstream boundary condition for the model runs was obtained from a harmonically derived tidal signal synthesized from National Ocean Service (NOS) harmonic constituents. These constituents were obtained from an analysis of observed tides from the Sandy Point, Maryland recording station. The upstream boundary condition was assigned a constant inflow of 35,000 cfs, based on inflow data obtained for the Susquehanna River. The Susquehanna River inflow data represented a typical long-term average discharge based on available annual data.

A seventy-five hour period of spring tides was selected to drive the model at the tidal boundary. Tide data were specified at half-hour time steps. Model data on water level and flow velocity (speed and direction) were saved at 10 specified nodes (Figure 5-2) for hours 25 through 75 of the simulation for both the "base" and "plan" conditions model runs.

5.1.2. Model Results

Ten nodes (discrete points on the model mesh) within the overall study area were selected for comparison of "base" and "plan" velocity magnitudes and surface water elevations. These nodes were selected to provide spatial coverage of the proposed placement sites G-East and Site 92, as well as for locations in the general vicinity around the sites. Time series of water velocity magnitude from each node were then utilized to compare the base and plan conditions. Plots of velocity vectors, indicating instantaneous values of current speed and direction, were also generated and saved to portray circulation patterns.

5.1.2.1. Velocity and Elevation

Comparison of the velocity magnitude results revealed that the plan condition was not significantly different from the base. Similarly, analysis of surface water elevation results revealed that the base and plan conditions were essentially the same; no change in water elevation was noted between the base and plan model runs in the study area. Figures 5-3 and 5-4 presents vector plots of instantaneous velocity at peak ebb (hour 31) of the 75 hour simulation for the base and plan conditions. These are included here as examples of the type of graphical data representation possible with the model results, and to qualitatively demonstrate the essentially undetectable differences in velocity distribution between the base and plan conditions. Data from peak ebb conditions at hour 31 were selected because the greatest likelihood of detecting a difference between the base and plan conditions occurs when the velocities are at their maximum. No additional vector plots are included because they would be redundant in illustrating the point conveyed by Figures 5-3 and 5-4.

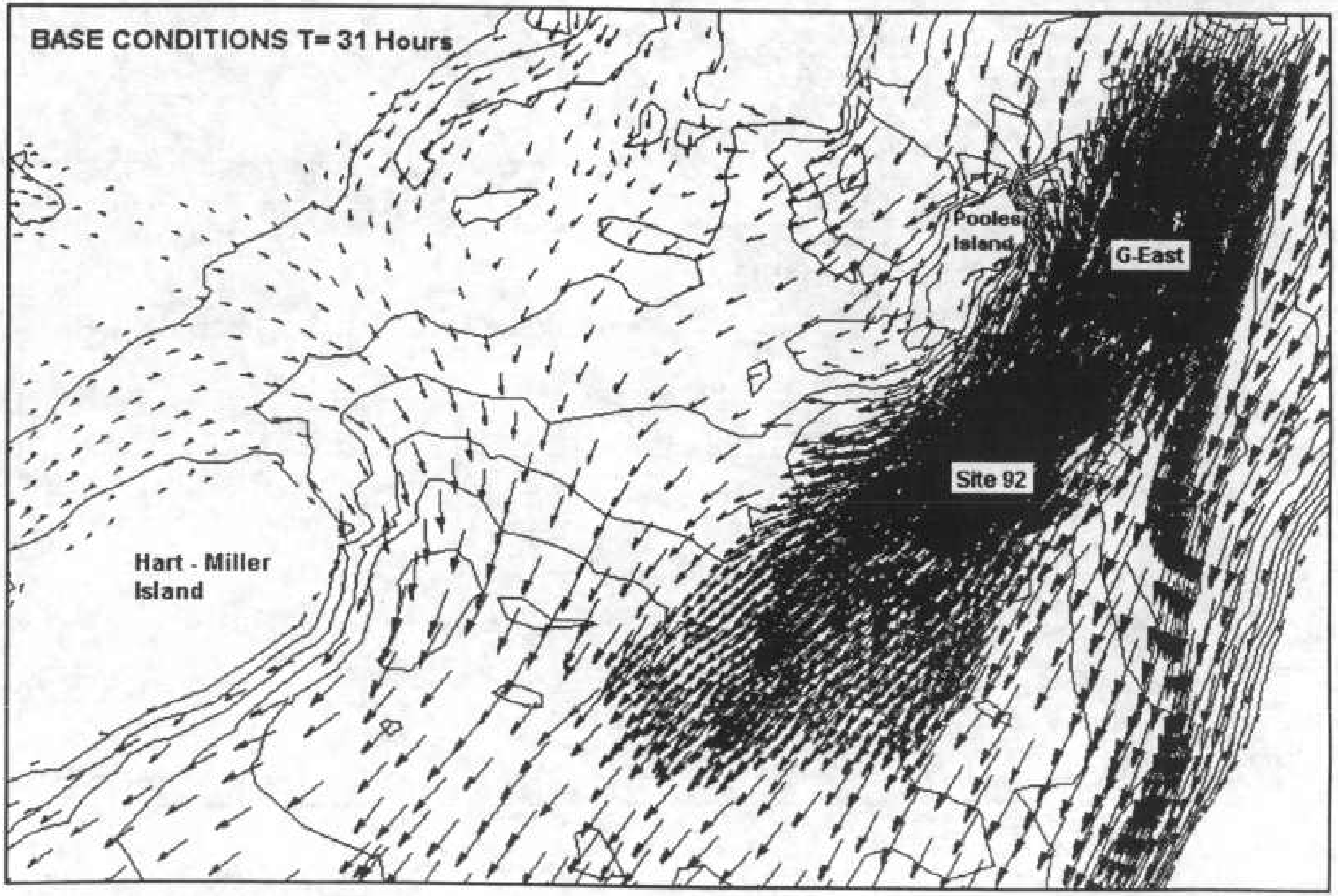


Figure 5-3: Vector Plot of Base Conditions, Hour 31, Maximum Ebb

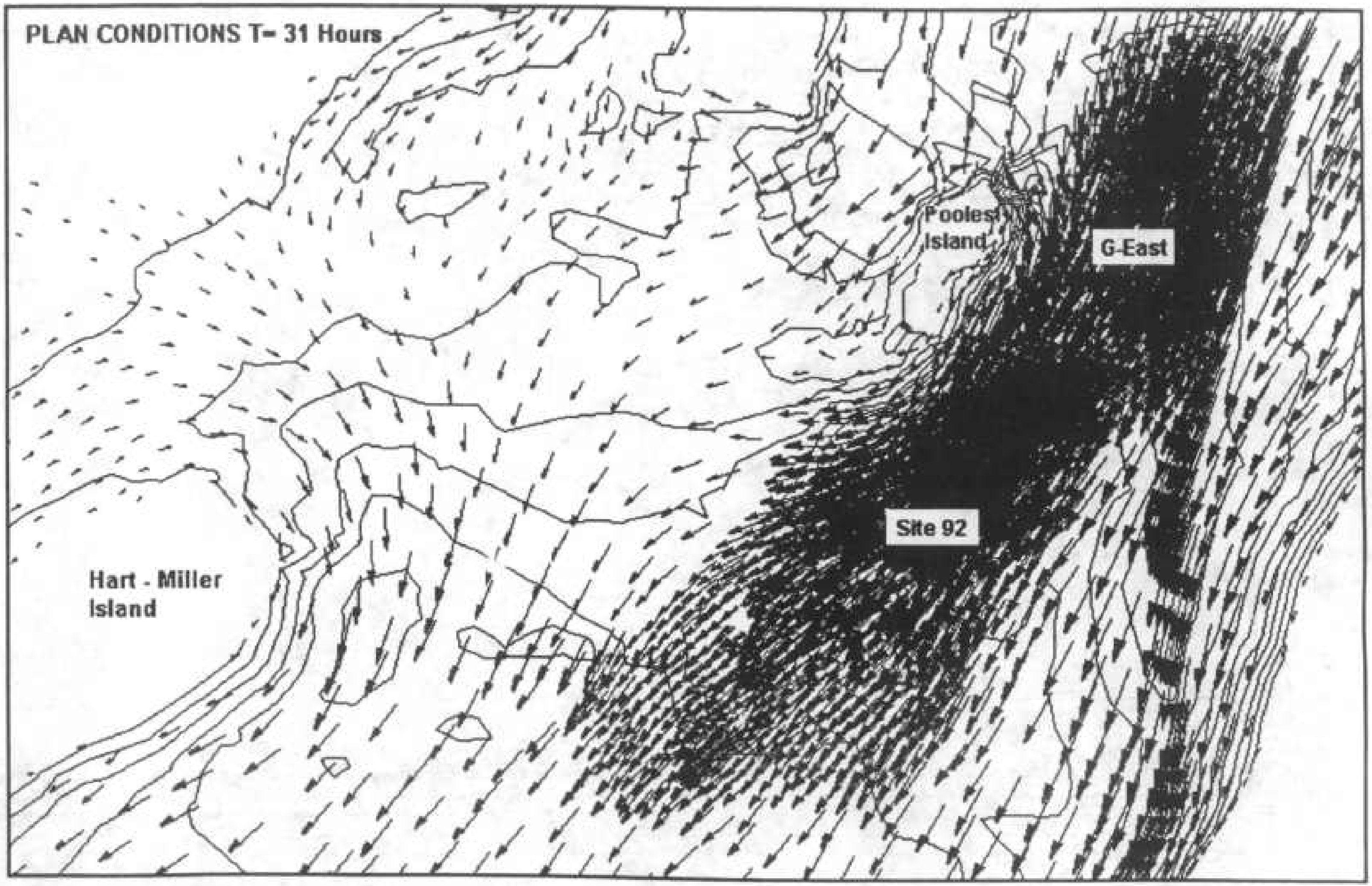


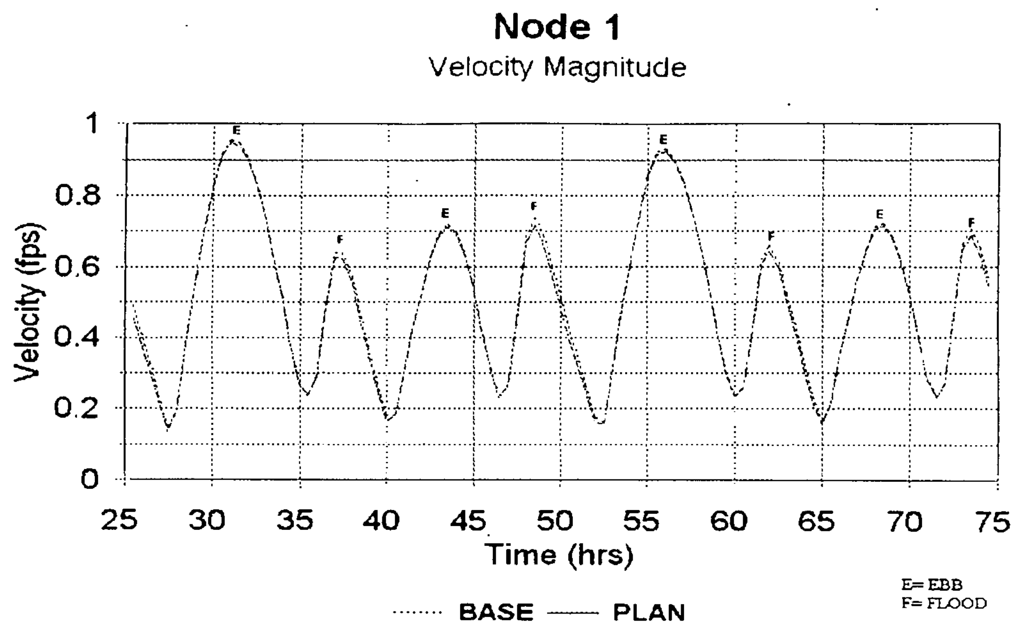
Figure 5-4: Vector Plot of Plan Conditions, Hour 31, Maximum Ebb

Figures 5-5 through 5-9 are time series plots of velocity magnitude at model nodes 1 through 10. Refer to Figure 5-2 for the location of each of the nodes. These plots show the variation in the flow velocity at each node for hours 25 through 75 of the model simulation. Each plot shows the base and plan velocity time series for a given node. The most significant finding relative to these velocity time series is the degree of similarity between the base and plan conditions at each node. Close examination of the data shows that some nodes experienced slightly higher velocities at peak ebb and peak flood for the plan condition compared to the base, and some nodes experienced slightly lower velocities. However, in view of the large natural variation in velocity at each node over the simulated tidal cycles, it is concluded that the modeled velocity differences represent a negligible impact.

5.1.2.2. Circulation

Velocity vector comparisons indicated that the circulation patterns did not vary significantly between base and plan conditions. The flood flow direction over G-East and Site 92 was approximately 45 degrees (flow direction toward, measured clockwise from north), with ebb flow direction at about 225 degrees. The largely negligible differences between the base and plan conditions indicate that there is essentially no impact on flow speeds or direction due to the proposed placement plan.

In addition to the vector plot and node time-series comparisons, an additional feature of FastTABS is the ability to visualize "particle tracking" using a "film loop" animation of the simulated time period. This feature of FastTABS reveals aspects of circulation patterns within the modeled area which may not be evident from vector or time series plots. This procedure was employed with the G-East and Site 92 analysis; however, the visualization process is effective only on a computer monitor, and is not readily transferable to "hard copy." For this reason, graphics from the particle tracking are not included in this report. The time period from hour 25 to hour 75 was utilized for the base and plan condition model runs. Particle tracking options regarding track length, particle spacing, etc., were selected to optimally reveal the major features of the circulation regime in the zone surrounding G-East and Site 92. The particle tracking indicated that flow in the navigation channel was essentially reversing bi-directional, whereas flow in the zone between Pooles Island and Hart-Miller Island was typically rotary, i.e., the tidal current never goes "slack," and a particle of water tends to describe a rotary path during successive ebb and flood tide cycles. A qualitative comparison of the base and plan particle tracking simulations revealed no detectable differences in circulation patterns as a result of the proposed dredged material placement at G-East and Site 92.



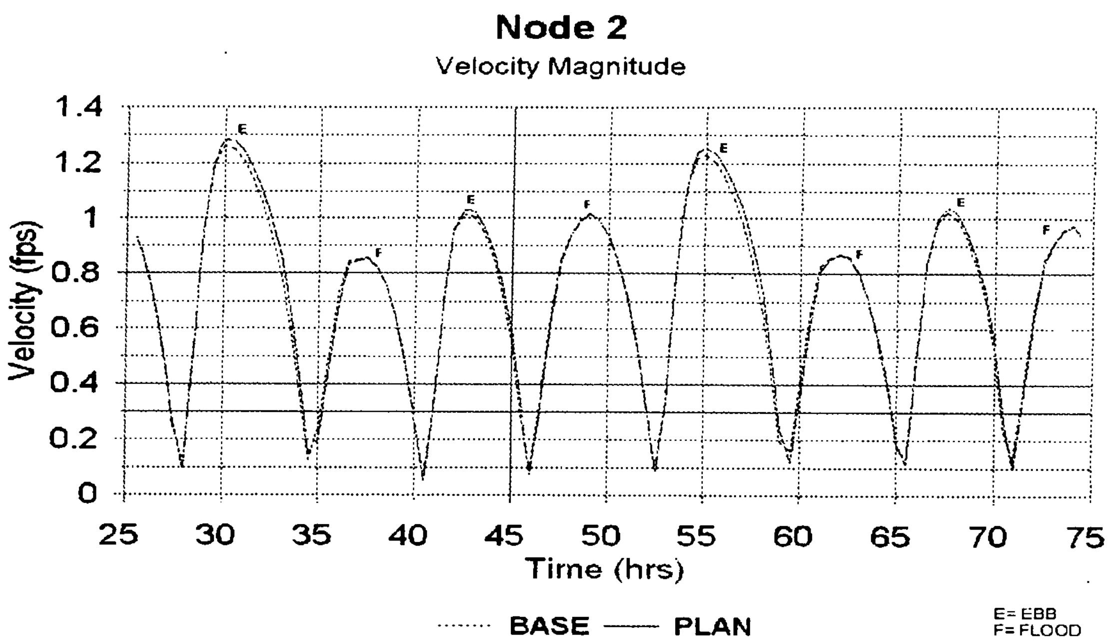
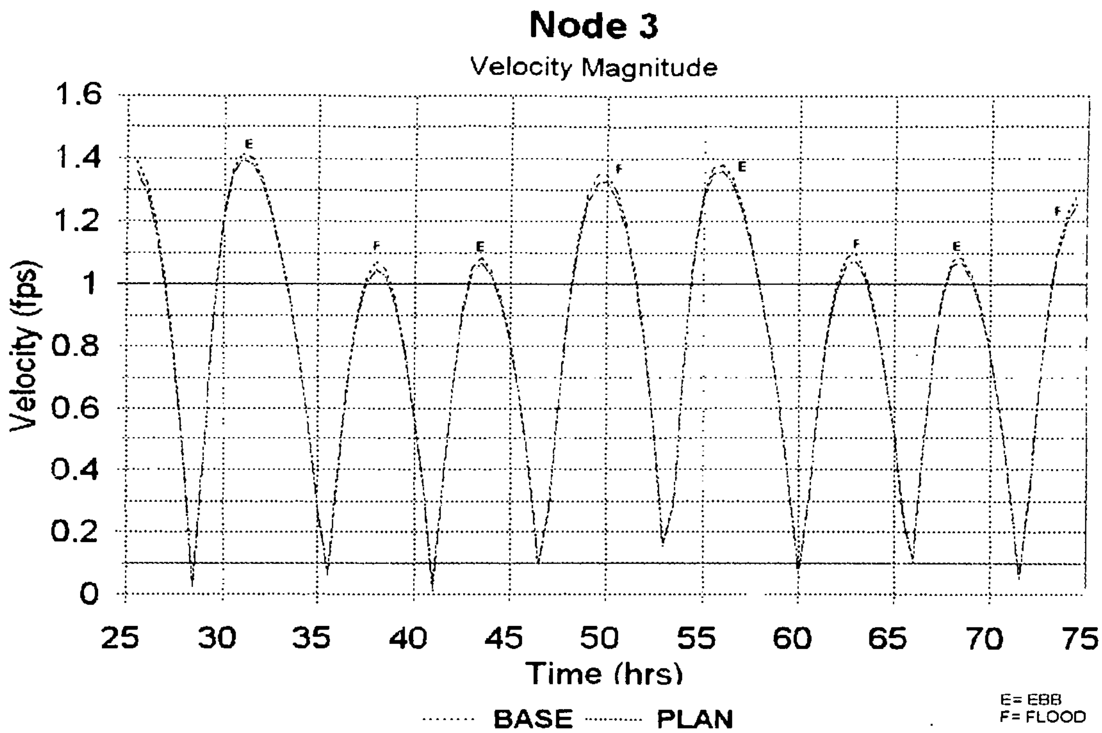


Figure 5-5: Velocity Magnitude Time Series, Nodes 1 & 2



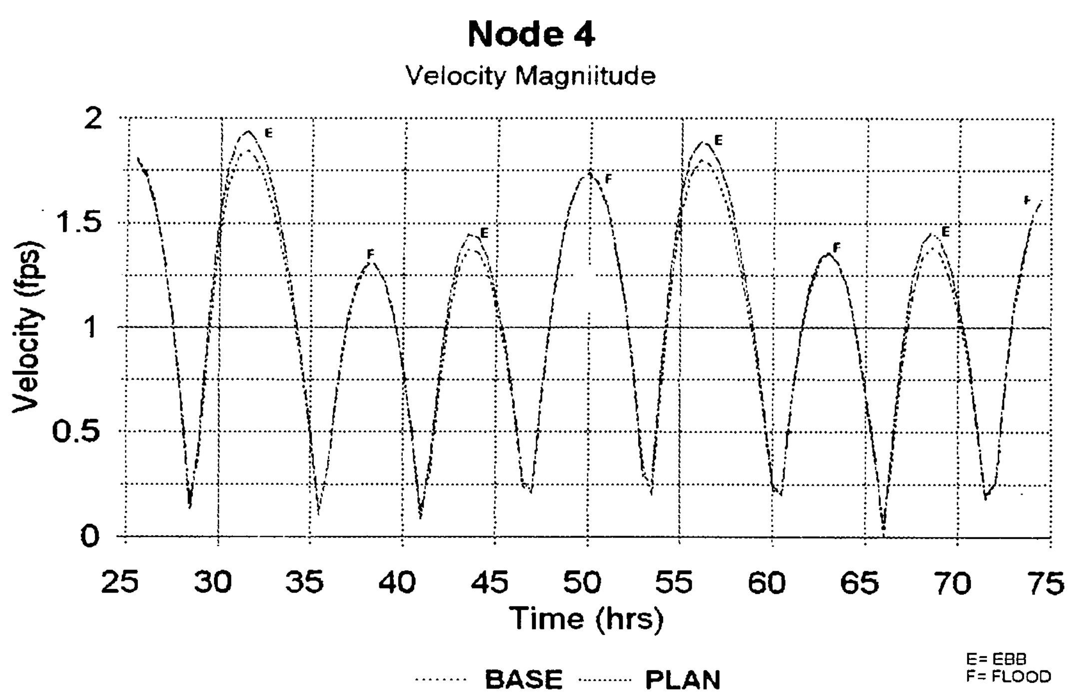
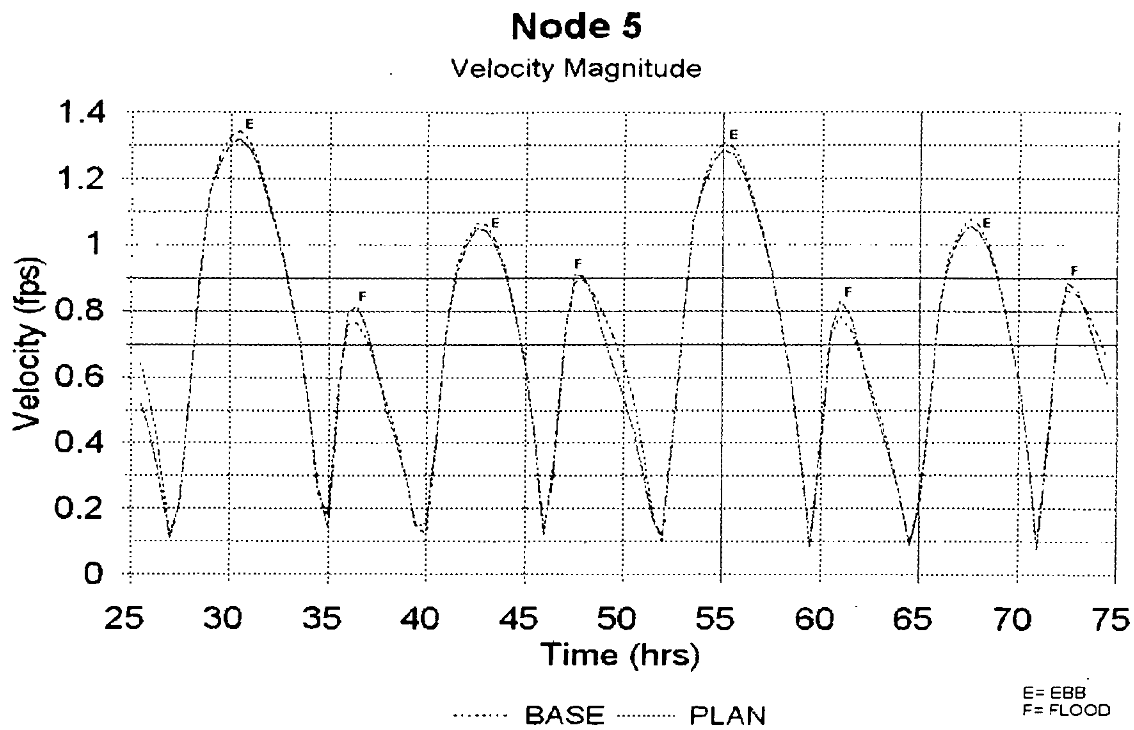


Figure 5-6: Velocity Magnitude Time Series, Nodes 3 & 4



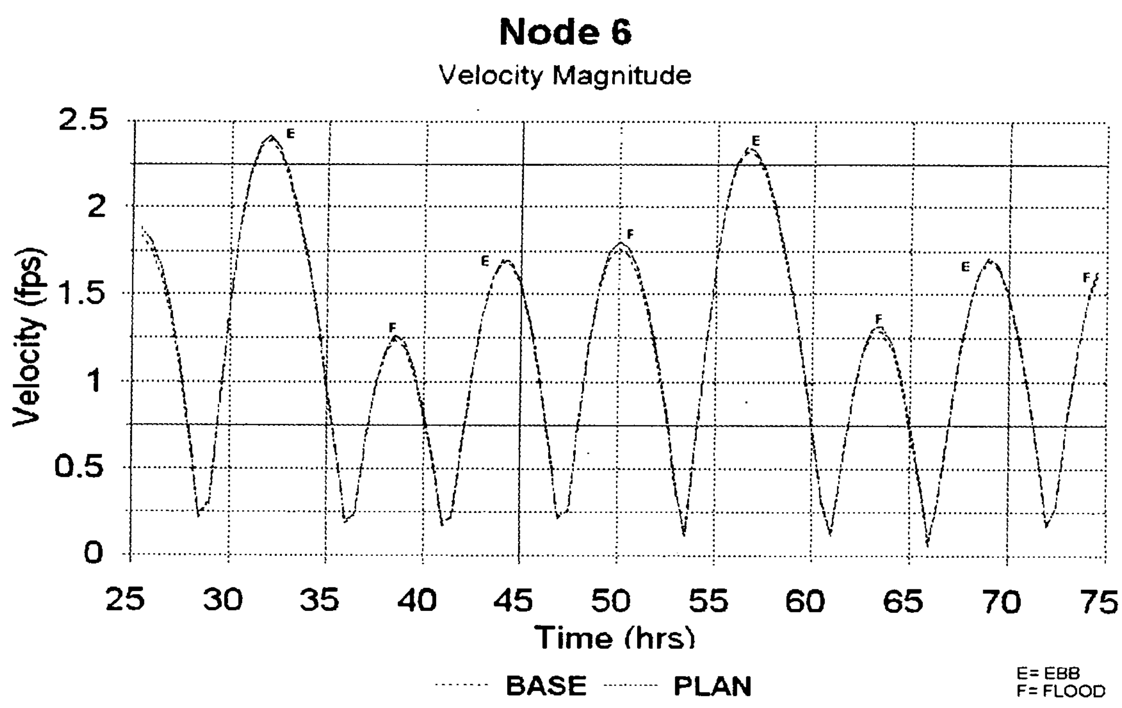
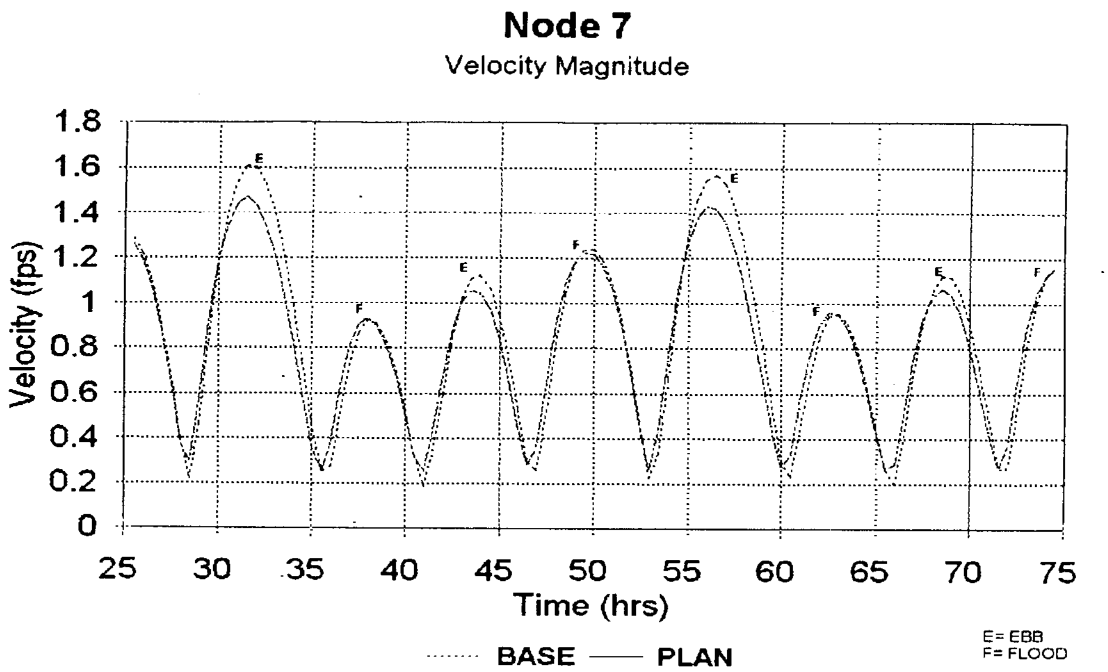


Figure 5-7: Velocity Magnitude Time Series, Nodes 5 & 6



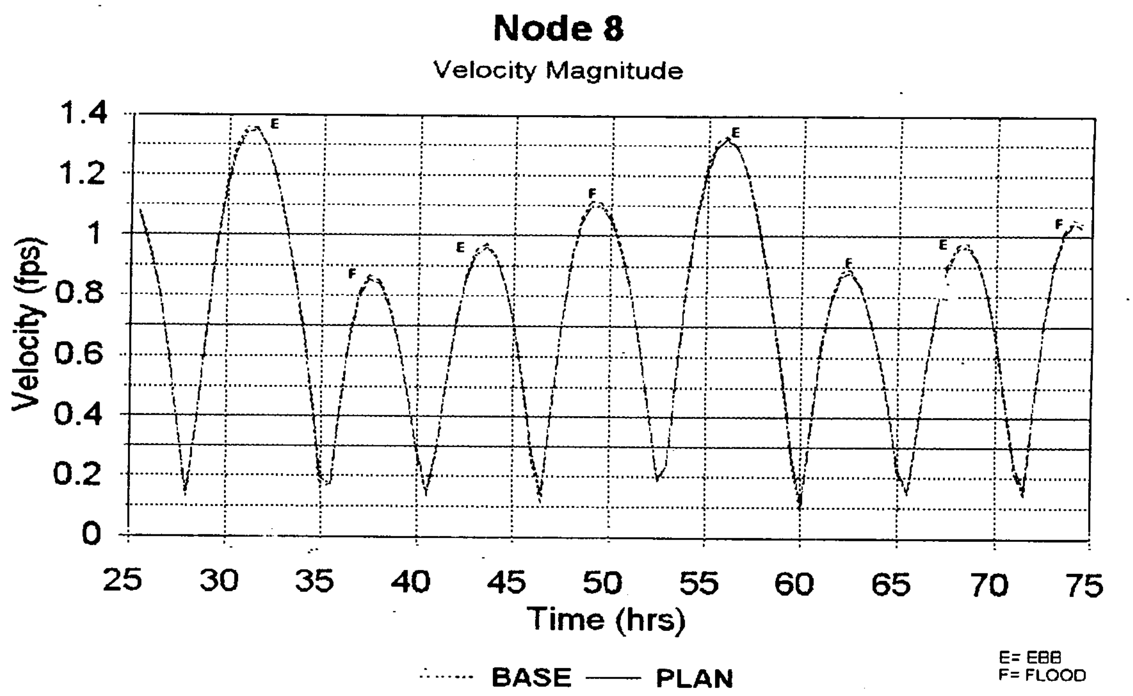
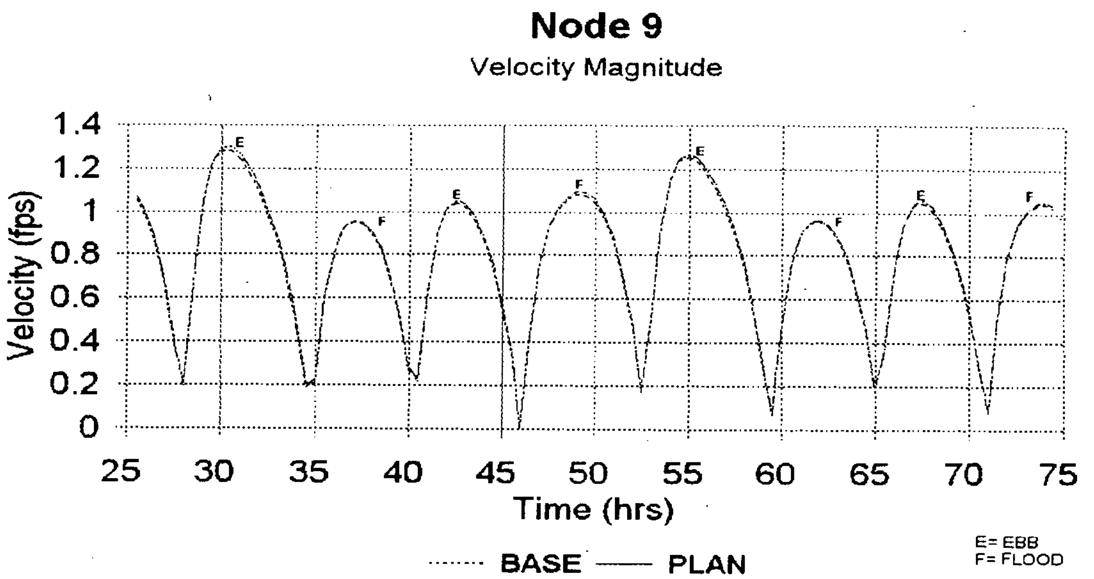


Figure 5-8: Velocity Magnitude Time Series, Nodes 7 & 8



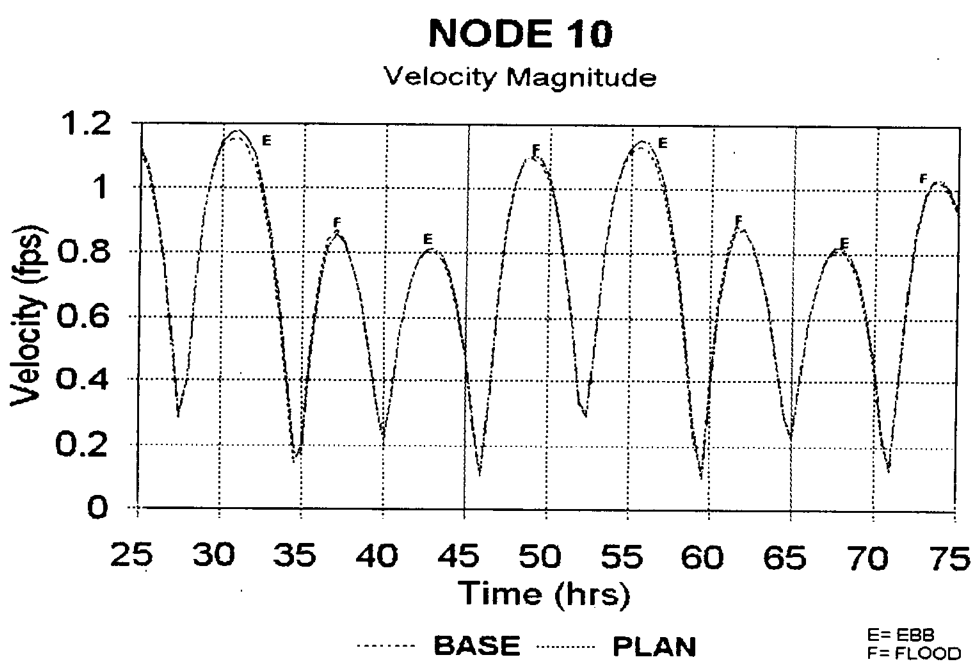


Figure 5-9: Velocity Magnitude Time Series, Nodes 9 & 10

5.1.3. Conclusions

Modeling the hydrodynamic impacts of placement of dredged material in G-East and Site 92 revealed no significant effects on velocity magnitudes, surface water elevations or circulation patterns in the study area. Based on the lack of significant effects on the hydrodynamics in the Pooles Island area noted during the modeling, no velocity changes or circulation impacts are anticipated due to the proposed dredged material placement.

5.2. PHYSICAL AND CHEMICAL IMPACTS

Physical and chemical impacts associated with the proposed placement of dredged material in G-East and Site 92 are related to turbidity plumes at the time of placement, sediment transport, possible contaminated sediments, nutrient releases and resulting phytoplankton blooms. As noted in the following sections, there are no long-term or regional physical or chemical impacts associated with dredged material placement in G-East and Site 92.

5.2.1. Turbidity Plumes and Sediment Transport

The extent and behavior of turbidity plumes and sediment transport has been monitored and studied by MGS. MGS reported that studies of hydraulic placement in Pooles Island placement Area D revealed that the vast majority of deposited sediment descended to the bottom as a slurry (Panageotou and Halka, 1990). A small portion of the material was dispersed as a turbidity plume that extended no farther than 1,641 feet (0.5 km) downcurrent during periods of strong current velocities. Sediments settling out of the turbidity plume resulted in a minor depositional process compared to movement of placed sediments on the bottom. Deposited sediments were reduced in volume by approximately 32% within the first five months post-placement; 10% of this reduction was due to consolidation. After five months, the sediments continued to consolidate and erosion was reduced.

MDE also studied the effects of turbidity plumes and sediment transport on water quality within the area of dredged material placement at G-South and G-North (Austin *et al.*, 1991). Dredged material was placed utilizing bottom release scow placement techniques. These studies found that the greatest near-field impacts to water quality from the turbidity plumes were from increased total phosphorus and total suspended solids concentrations, and increased turbidity. There were no regional impacts to water quality. The near-field impacts were short-term as evidenced by the lack of impacts to regional water quality.

Studies by Versar in 1991 and 1992 of dredged material placement utilizing hydraulic bottom release placement techniques studies found that the turbidity plumes from hydraulic placement operations were much larger than from bottom release scow operations; greater than 9,843 feet (3 km) and less than 2,297 feet (0.7 km), respectively (Versar, 1994). The hydraulic release plumes were nearly 2.5 times longer than bottom release scow plumes, though both types of plumes were similar in width. The concentration of suspended solids in the bottom release scow turbidity plume returned to ambient levels within 20 to 40 minutes; no measurement was made for the hydraulic release turbidity plume. Total suspended solids concentrations of the plumes represented approximately 1% to 5% of the total sediment deposited.

The monitoring studies reported by Versar (1994) verified that the turbidity plumes had a near-field, short-term impact on the area of dredged material placement. Suspended sediment levels in the plumes were well below ranges considered acutely toxic to fish and plumes generally lasted for 20 to 40 minutes from barge release operations. Plumes from hydraulic operations lasted longer but did not result in significantly higher levels of turbidity. The monitoring studies also indicated that the placed sediments were not resuspended in significant concentrations and that turbidities were not significantly higher, once the turbidity plumes had dissipated, when compared to natural turbidity levels in the upper Bay (Versar, 1994).

The finding that resuspension of placed sediments did not contribute to the turbidity of the area was verified by MGS when studying placement operations in G-South (Halka *et al.*, 1994). MGS found that any elevated suspended sediment concentrations were localized in time (less than seven months) and space and that there was no evidence of enhanced background suspended sediment concentrations, even immediately after placement MGS summarized the study by stating that: "Evidence accumulated here and in previous studies indicates that, under normal conditions, there is a brief period of time during which there may be enhanced resuspension and redistribution following placement, but this effect is small compared to that of large, natural events."

G-West turbidity plume studies performed by MGS during berm creation in March of 1994 found that the turbidity plumes resulting from placement activities ranged in width and length depending on the tidal direction and strength of current at the time of placement (Halka *et al.*, 1995). The berm was created utilizing bottom release scow techniques. Suspended sediment concentrations in the plume generally showed a zone of high concentration, with values exceeding 150 ppm and a low to medium concentration, with values ranging from 150 ppm to less than 50 ppm. Ambient total suspended sediment concentrations averaged 20-30 ppm during this timeframe. Plume widths ranged between 722 and 1128 feet (220 and 350 m), and lengths ranged from 394 feet (120 m) to nearly 3,281 feet (1000 m). Direction of the plume was in a northeasterly direction during flood tide, with the plume remaining almost entirely within the designated G-West site. Plumes were very small during slack tide, staying very close in proximity to the drop zone. During ebb tides, plumes ran southwesterly and within the general confines of the natural trough in this area of the bay. Significant turbidity was associated with the positioning of the scows over the drop zone, presumably due to prop wash from the tugs. Suspended solid concentrations within the plumes returned to ambient levels within 40 to 45 minutes after placement ended and concentrations outside the plumes never exceeded levels which naturally occur in the Bay.

In respect to sediment transport issues, MGS found, while studying berm creation at G-West, that consolidation of the placed material accounted for very little of the volume reduction in the first year post-placement. In a 1996 study of placement of dredged material at G-West, MGS concluded that: "Dredging, and the turbidity it induces, represents an addition to the cycle of resuspension and settling which fine-grained sediments normally undergo in the Bay. The direct impact of placement operations is minimal when considered within the context of natural levels of suspended sediment concentrations" (Panageotou *et al.*, 1996). Studies at G-West in 1994 estimated a 1% loss of material due to turbidity plumes at the time of placement. In the six months after placement of the G-West berm, a 12.9% volume reduction occurred. Investigation of the impact of transport of fine grained sediments from a placement area was performed by MGS. Using the 2-D model, they found that material generally moves in such a manner that it can not be detected as a change in bathymetric depth anywhere in the upper Bay (Halka & Panageotou, 1993).

Because the levels of turbidity are naturally high and there is a tremendous amount of fine grained sedimentation in the Pooles Island area, the added turbidity caused by the placement of dredged material is thought to be minimal (Panageotou *et al.*, 1996). In addition, the sediments in the Pooles Island area, and throughout the turbidity maximum zone, are similar in grain size to those which are dredged from the C&D Canal northern approach channels, so their behavior after placement should be similar to that of the existing sediments and they will be subject to the same estuarine sedimentary processes.

Based on the aforementioned studies, dredged material placement at G-East and Site 92 will have short-term, near-field effects on suspended sediment concentrations in the placement area and will have no long-term, or regional effects. As discussed in Sections 3.2 and 3.3, placement in G-East and Site 92 will be designed and conducted in a manner that minimizes sediment transport from the site due to erosion or resuspension of sediments. Techniques utilized will include construction of a berm in each of the sites to prevent dispersion of material into adjacent areas and restricting the depth of placement to -16 feet (-4.8 m) MLLW in G-East and -14 feet (-4.2 m) MLLW in Site 92.

5.2.2. Contaminated Sediments

Studies of the dredged sediments in the C& D Canal northern approach channels found that organic and metal contaminant concentrations were low and similar to levels observed in reference areas, which are considered relatively pristine (Versar, 1994). Sediment from the C&D Canal northern approach channels, which is the sediment that will be placed in G-East and Site 92, has been tested extensively and exhibits no toxicity. As stated in Section 4.2.3, lead values for channel sediments were found to be higher than PEL values (Versar, 1994) but were well within EPA "safe" levels (MES, 1993). Ammonia-nitrogen and zinc were the only other two constituents detected at concentrations greater than the EPA's AWQC. However, additional toxicity studies with the epibenthic amphipod, *Leptocheirus plumulosus*, indicated that the channel sediments placed at Pooles Island were not toxic (Versar, 1992). Analysis of sediments placed in the Pooles Island area indicated that no priority pollutant organic contaminants were detected and that metal concentrations were similar to ambient levels around Pooles Island (Versar, 1993). Chemical analysis of the sediments from the C&D Canal northern approach channels found low levels of contaminants. Therefore, placement of the C&D Canal northern approach channel sediments in the Pooles Island area is unlikely to have any adverse or toxicity related impacts (Versar, 1994). Furthermore, the use of G-East and Site 92 will not involve placement of contaminated material (see Section 4.2.2). Therefore, dredged material placement at G-East and Site 92 will not result in impacts to the existing environment resulting from contaminated sediment.

5.2.3. Nutrients

Nutrients and their potential impacts to water quality and living resources are a primary concern to the restoration of the Chesapeake Bay ecosystem. The monitoring program for the Pooles Island area has, and continues to provide, valuable information for the Chesapeake Bay program database that tracks the nutrient levels of the Bay. The sources of nutrients which may impact G-East and Site 92 are: (1) the water quality impacts during dredged material placement; and (2) the ongoing flux of nutrients from sediments to the water column.

Studies conducted on the placement of dredged material utilizing bottom release scow techniques in the Pooles Island area in early 1990 found that there were no significant differences in total nitrogen (TN) or dissolved inorganic nitrogen (DIN) concentrations from pre- to post-placement (Austin *et al.*, 1991). Surface concentrations of ammonium (NH_4) were generally naturally low and variable in the Pooles Island region of the Bay. Therefore, fluxes in NH_4 during cruises were difficult to attribute to dredged material placement activities. Total phosphorus (TP) concentrations were not out of the range that is typical for the Pooles Island region and there were no apparent differences in dissolved inorganic phosphorus (DIP) concentrations pre- and post-placement. DIP naturally fluctuates in this region. The 1990 study concluded that there were several short-term, near-field impacts to water quality associated with placement but no long-term or regional water quality impacts (Austin *et al.*, 1991).

Monitoring of reference areas near Pooles Island as part of the G-West placement monitoring programs have found that background levels of dissolved nutrient concentrations were within expected ranges for the Pooles Island region (Boynton *et al.*, 1994; Boynton *et al.*, 1995). Monitoring found that DIP concentrations were generally lower compared to other regions of the Bay and that nitrite (NO_2^-) concentrations were also low in 1993, 1994 and 1995. Concentrations of nitrite plus nitrate ($NO_2^- + NO_3^-$) and silicate ($Si(OH)_4$) were high in 1994 but moderate in 1993 and 1995. The high concentrations in 1994 were attributed to riverine sources. The monitoring studies found low sediment particulate carbon to particulate nitrogen ratios (PC:PN), indicating that much of the sediment organic matter was not readily available to organisms for food and to decomposers as substrate.

The G-West hydraulic placement studies (Boynton *et al.*, 1995, and 1996a.) showed that sediment-water nutrient flux data collected prior to, during and after placement revealed temporary impacts to ammonium flux rates as a result of dredged material placement. Ammonium fluxes prior to placement (1993) were low relative to other regions of the Bay. In 1994, after placement, ammonium fluxes were significantly higher than in 1993 and were similar to those observed at very eutrophicated portions of the mid-bay region. The substantial increase in ammonium fluxes is attributed to activities of infaunal organisms as well as placement activities. It is especially important to note that ammonium fluxes in 1995 had returned to levels lower than in 1993. Similar conditions were observed in 1996 after placement in the 1995/1996 dredging season. Therefore, the findings of the sediment nutrient flux studies in G-West are that ammonium fluxes have a short term impact, which in the case of controlled bottom release placement, last through the first summer after placement, and after hydraulic placement, return to background levels by the first summer after placement.

The water quality impacts of this increase are deemed important on a local, rather than regional basis, according to Boynton *et al.*, (1995, 1996a). The coordinated water quality studies performed in the area by DNR and MDE since 1991 have, in fact, found no detectable changes to water quality in the area which can be attributed to the dredged material placement (Michael, 1994; Romano *et al.*, 1995; Dalal, 1996c).

Nitrite plus nitrate fluxes after placement at G-West were small and directed into the sediments at the berm site and small and either directed to or from the sediments at the hydraulic placement site, and small and directed to the water column at the reference sites after placement (Boynton *et al.*, 1995; MES, 1995b, Boynton, 1997). Nitrite plus nitrate fluxes directed into the sediments is a common occurrence in areas like the upper Bay where nitrate concentrations in the water column are high, however, since 1993 nitrate/nitrite fluxes in the reference sediments at G-West have been small and directed to the water column from the sediments. The placed dredged material has continued to exhibit small to moderate fluxes of nitrogen from the water column to the sediments up to three years after placement. In the principal investigator's opinion, this nitrogen is likely denitrified and is lost to the atmosphere as nitrogen gas (Boynton *et al.*, 1997). Boynton defines these nitrogen loss rates as small to modest in terms of overall nitrogen dynamics in this area of the bay. Overall, nitrite plus nitrate fluxes did not have a measurable effect on water quality.

Phosphorous fluxes were low and directed into the sediments at the G-West hydraulic placement and berm sites, representing a loss of phosphorus from the water column. This loss was small and did not have an effect on water quality (Boynton *et al.*, 1995; MES, 1995b, Boynton *et al.*, 1997).

Monitoring of Area G-West before (1989-1994) and after (1994,1995,1996) dredged material placement revealed no significant impacts on water quality conditions in the surface or bottom layers after placement (MES, 1995b; Romano *et al.*, 1995, Dalal, 1996c). Monitoring also found that some nutrients seemed higher in surficial waters than in bottom waters during November 1995. This difference in nutrient levels was attributed to the high flows from the Susquehanna and other upper Bay tributaries in the region. The 1996 monitoring report for G-West concluded that there were some short-term (few days to a month) changes in nutrient levels but there were no significant long-term (month to season) or regional changes in the water quality (MES, 1995b; Dalal, 1996c).

The use of G-East and Site 92 is projected to result in short-term, near-field impacts to nutrient levels in the area, similar to those found in G-West monitoring. Research presented in Section 4 and above shows that there are no regional impacts to nutrient levels associated with dredged material placement. Therefore, dredged material placement will not negatively impact the Chesapeake Bay Program's (CBP's) 40% nutrient reduction goals (CBP, 1994) or have long-term or regional impacts on the Pooles Island area. A further discussion of the nutrient impacts of dredged material placement and the Chesapeake Bay nutrient reduction goals is presented in the cumulative impacts section of this document.

5.3. BIOLOGICAL IMPACTS

5.3.1. Water Quality

5.3.1.1. Dissolved Oxygen

Dissolved Oxygen (DO) concentrations in the Pooles Island area are naturally high and there are no indications of hypoxic conditions during summer months (Boynton *et al.*, 1994). Studies at G-Central after dredged material placement found that bottom waters remained well-oxygenated and near saturation levels and that the sediments had a positive Eh value down to 10 cm, indicating a movement of DO from the water column to the sediments (Versar, 1993).

DO levels in the Pooles Island area have been monitored for several years to determine the impacts of dredged material placement (Austin *et al.*, 1991; Michael, 1994; Romano *et al.*, 1995; Dalal, 1996c). No anoxic waters have been detected, although dissolved oxygen levels below 5.0 mg/l have been detected, and a pycnocline has been observed during low flow years near the southern reference station, which is within the Site 92 boundaries. Figure 4.2 (Section 4.2) illustrates DO levels from the water quality monitoring station MCB3.1 from 1987 to 1995.

Studies of the sediments after placement detected recolonization by benthic organisms within 12 to 18 months after placement. Recolonization can only occur in oxygenated sediments, with DO present in the overlying water. The oxygenation of the sediments has been verified by Boynton's sediment nutrient flux studies, which have always found well-oxygenated sediments down to at least 0.16 inches (5 cm) (Boynton, *et al.*, 1997). Thus, dredged material placement has not been responsible for the creation of an anoxic environment in the sediment or the water column in the past. No changes in dredged material placement practices are anticipated. Therefore, hypoxia or anoxia are not expected to develop as a result of dredged material placement in G-East and Site 92.

Berm construction and placement monitoring of G-West revealed no effects from placement on DO in the area, even though sediment oxygen consumption rates did rise in the first year after placement on the berm (Boynton *et al.*, 1995; MES, 1995b). Monitoring studies performed by UMCEES stated that an increase in stratification and a substantial increase in sediment oxygen consumption would be necessary before hypoxia or anoxia would be possible in this area of the upper Bay (Boynton *et al.*, 1993). Neither of these conditions are anticipated.

Based on comprehensive monitoring of G-West, which is in close proximity to G-East and Site 92, dredged material placement at G-East and Site 92 will have near-field, short-term effects on DO levels but no long-term or regional effects.

5.3.1.2. Turbidity

Because the Pooles Island area lies within the turbidity maximum zone of the upper Bay, elevated turbidity levels are expected and natural in this zone. Increased turbidity is expected for brief periods following dredged material placement, but these effects are limited to near-field and short-term impacts. Turbidity plumes dissipate quickly, depending on factors such as wind, grain size distribution, currents, other disturbances that cause sediments to remain in suspension and placement techniques (Halka *et al.*, 1994). Berm construction in G-East and Site 92 will utilize bottom release scow techniques, placement in G-East along the northern and eastern edge will utilize bottom release scow techniques. Placement of dredged material in G-East and Site 92, except for the berms and the previously mentioned areas in G-East, will be either hydraulic placement or bottom release scow techniques. Section 4.3.1.2 presents a more detailed discussion on the results of turbidity plume and sediment transport studies in the Pooles Island area under similar conditions to those expected at G-East and Site 92.

5.3.2. Submerged Aquatic Vegetation

The State of Maryland prohibits the placement of dredged material in areas where submerged aquatic vegetation (SAV) populations are present (CBP, 1995). SAV is not generally viable in the Chesapeake Bay at depths greater than 6.5 feet (2 m) due to natural light limitations (Hurley, 1990; Batiuk *et al.*, 1992). The G-East and Site 92 placement areas will not be filled above -16 feet and -14 feet (-4.8 and -4.2 m) MLLW, respectively, and are currently deeper than -16 and -14 feet (-4.8 and -4.2 m) MLLW, respectively. There are no known SAV beds in G-East and Site 92 and these areas would not support an SAV community once placement had occurred.

Although there are no SAV beds in G-East and Site 92, there are additional indirect effects from placement that have been considered: (1) proximity of the proposed placement action to historically documented SAV beds; (2) resulting turbidity plumes from placement activities that may adversely effect SAV in the Pooles Island area; and (3) timing of the placement action in relation to SAV critical life stages. After evaluation of these potential effects it has been determined that placement of dredged material at G-East and Site 92 is consistent with the *Guidance for Protecting Submerged Aquatic Vegetation in Chesapeake Bay from Physical Disruption* (CBP, 1995). The CBP guidance suggests that during the SAV growing season a 500 yard buffer be established between known SAV beds and activities which create additional turbidity. Outside of the growing season, narrower buffers can be established. The closest documented SAV bed is in the eastern Pooles Island cove which is 3500 feet (1050 m) from G-East and 5000 feet (1500 m) from Site 92 (Bortz, APG, pers. comm., Jan. 15, 1997). This is SAV bed is much further from the proposed placement areas than the CBP suggested buffer width of 500 yards (457 m). Also, placement would occur between October and March, when most SAV are dormant. Therefore, no adverse effects on SAV beds in the Pooles Island area are expected.

5.3.3. Benthic Macroinvertebrates

There have been benthics studies prior to dredged material placement of G-West, G-South, and reference areas in the vicinity of G-East and Site 92. Studies conducted in areas G-North, G-Central, G-South and G-West found similarities to G-East and Site 92 in bathymetry, hydrology, substrate composition and water quality parameters (Halka and Panageotou, 1992; Boynton *et al.*, 1996a; Austin *et al.*, 1991). Therefore, information gathered for the G-West EA and Comprehensive Monitoring Plan and in G-South and the reference areas are applicable to this evaluation of G-East and Site 92. All of these areas are located within a 2.5 miles radius of Pooles Island and are west of the C&D Canal northern approach channels.

Because the upper Bay is a naturally unstable environment and the dominant benthic species are opportunistic (refer to Section 4.3.3.), an event such as dredged material placement would have a temporary impact on the benthic community. A key component to the temporary nature of the impacts is that the composition of the dredged material is similar to the existing substrate, thereby allowing for rapid recolonization of the area (Cronin *et al.*, 1970). Research has shown that areas are recolonized in twelve to eighteen months after the end of dredged material placement (Ruddy, 1990; Cronin *et al.*, 1970). Cronin *et al.* (1970) indicated that immediately after placement there was a 71% decrease in the average number of individuals per sample within the placement area and an 11% increase in stations outside the placement area. This may have been due to hydrologic pushing or migration of individuals out of the placement area during or after placement. The increase in the number of individuals outside of the area may have also contributed to the rapid recolonization of the area. Cronin *et al.* (1970) advised that placement of dredged material occur during the period from late fall to early spring to avoid the period of high species diversity and organism distribution and thereby, cause the least amount of impact to the benthic community. October to March (fall to early spring) is the window that placement typically occurs in and during which placement in G-East and Site 92 would occur.

As discussed in Section 4.3.3., the mud substrate, low mesohaline to oligohaline zone is not considered an area that exhibits high macrobenthic productivity when compared to the southern Bay. Therefore, temporary impacts resulting from dredged material placement in late fall to early spring are not projected to have long-term adverse impacts to the area's benthic productivity. In support of this concept, Cronin *et al.* (1970) observed no gross effect of dredged material placement in the Pooles Island area on phytoplankton primary productivity, zooplankton, fish eggs and larvae, and fish. If the impacts to the benthic community had severely impacted productivity there would have been a notable impact to fish larvae, reproduction and activity. Some decreased fisheries abundance was observed in placement areas D, E, F, G-North, G-Central and G-South, but it was not statistically significant nor attributable to site conditions after placement (Versar, 1994; Weimer *et al.*, 1996). Studies in G-West during and after placement activities have shown that fisheries abundance are within the range of those at reference areas (Weimer *et al.*, 1996).

Benthic assemblage studies of G-Central and Areas D, E and F after dredged material placement indicated that the benthic assemblages at these placement areas recovered from localized placement effects within nine to eleven months and that no regional placement effects were detected (Ranasinghe and Richkus, 1993). The Versar studies revealed a more rapid recovery in these areas than research studies have shown in dredged material placement Areas A, B and G-West (1994).

Post-placement studies of G-Central (October 1992) and G-South (May 1993) indicated that the benthic assemblages had recovered to a "state indistinguishable from the reference areas" within eleven months of the end of the placement activity (Versar, 1994). These studies also found that bottom release scow placement of material resulted in a lower number of benthic species and significantly lower total abundance within the first eight months after placement then hydraulic placement of material.

Benthic sampling by MDE in the vicinity of G-East and within G-South showed that the benthic communities were within appropriate Chesapeake Bay Index goals (Dalal *et al.*, 1996a; Dalal *et al.*, 1996b). This reflects recovery of G-South in 1996 after dredged material placement, which prior to the benthics sampling had last occurred in 1993, and prior to additional dredged material placement in 1996/1997.

Placement will occur during periods of low species diversity and organism distribution. The benthic community should recover to pre-placement diversity and distribution within nine to eighteen months of the end of dredged material placement. According to Ranasinghe and Richkus (1993): "the magnitude of natural changes with potential ecosystem and living resource management consequences far exceeded the effects of dredged material placement." Therefore, dredged material placement within G-East and Site 92 would have near-field, short-term effects on the benthic community but no long-term or regional impacts.

Under current practice, additional baseline characterization of the existing benthic community at G-East and Site 92 would be performed prior to dredged material placement. Monitoring and placement activities in the areas would be coordinated with MDNR.

5.3.4. Plankton

The existing conditions at Pooles Island indicate a region of relatively low primary productivity (Ruddy, 1990). Sediment-related nutrient releases of nitrogen are 25% of riverine sources and phosphorus is estimated to be 80% of riverine releases to the Bay (Boynton *et al.*, 1993). Figures 4-2, 4-3, 4-4, and 4-5 (Section 4.2) illustrate long-term chlorophyll-a and nutrient concentrations. As explained in Section 4, these parameters have a direct effect on plankton.

Dredged material placement would result in temporarily increased turbidity and nutrients releases in the water column. Due to the time of the placement window (fall to early spring), naturally low levels of sediment nutrient flux, low phytoplankton productivity during the fall and winter seasons, and high levels of DO, no eutrophication or algae blooms and no adverse effects on water quality are expected.

As stated previously, phytoplankton productivity is naturally low in the Pooles Island area, especially during the Fall and Winter seasons, and phytoplankton mobility is dependent on environmental variables. Therefore, phytoplankton populations in the G-East and Site 92 areas would be dependent on the naturally occurring environmental variables during the spring, summer and fall following placement activities, and no impacts related to dredged material placement are anticipated. Long-term, regional impacts to the phytoplankton population would also not occur as a result of dredged material placement in G-East and Site 92.

Species compositions and densities of zooplankton in G-East and Site 92 and in the upper Bay are not unique. Zooplankton are also typically not present in the water column in sufficient densities during the fall and winter to result in effects on zooplankton densities the following season. Therefore, it is anticipated that the effects of dredged material placement on the zooplankton communities will be negligible and there will be no long-term effects from dredged material placement.

5.3.5. Fisheries

Individual life histories of target fish species common to the Pooles Island area are outlined in Appendix B. Specific habitat requirements are tabulated for different life stages for each target species. Figure 5-9 shows the critical life stage seasons overlaid with the placement operations window and other pertinent environmental factors. Figures 4-1 and 4-2 (Section 4.2), and Figure 5-10 show seasonal variations in the basic ecological parameters of salinity, dissolved oxygen and temperature, respectively, in the Pooles Island area. Habitat requirements of target finfish and shellfish species in the upper Bay are summarized in Table 5-1 (a complete description is included in Appendix B), and Table 5-2 summarizes potential effects on target species in the upper Bay that are in a critical life stage during the dredged material operations window.

Fish habitat is anticipated to change from waters of a maximum depth of 20 to 25 feet to waters of 14 feet in Site 92 and 16 feet in the reconfigured G-East area. The impact of these changes is not anticipated to be significant, because the existing bathymetry in Site 92 and reconfigured G-East does not provide a substantial amount of features considered important for fish habitat. Features which are considered to be in need of conservation for fish habitat include structures such as rocks or shell reefs which provide protection from predators and feeding habitat, deep water where fish overwinter (generally, depths greater than 30 feet [9 m]), shallow waters which are used as nursery areas for newly-hatched fish (generally, depths less than 6 feet [1.8 m] and vegetated), and hard bottom substrates used by some species for spawning. Reconfigured G-East and Site 92 were selected as preferred placement areas and delineated in a manner that limits impacts to these types of habitat and thus limits impacts to fisheries from placement activities.

In support of this previous statement, the northern-most portion of the original G-East configuration was excluded from further study due to issues related to fish populations and bottom relief. In addition to the efforts to select areas that do not provide unique fish habitat, the dredged material placement window avoids significant impacts to commercially and recreationally valuable fish species at critical life stages. Placement would not effect mobile adult fish populations, as the sites do not provide unique habitat for adult cohorts.

Table 4-2 (Section 4.5) summarizes a study that has been ongoing since December 1992 in the Pooles Island area. Differences in the data collected from G-West and the three reference areas suggests that natural inter-annual variability in the upper Bay, including the study area, can account for many of the differences between areas, seasons and years. Natural fluctuations in the reference areas, specifically reference area C, which is located south of Pooles Island and well outside the potential impact area from placement activities, support this conclusion. Bottom modifications in 1994 could account for the disparity in the data collected in G-West during the winter of 1994, when compared to baseline data, but the trends observed from 1994 to 1995 have indicated that the impacts are transitory and reflected those conditions exhibited in the reference areas, specifically Reference Areas B, located east of G-East, and C.

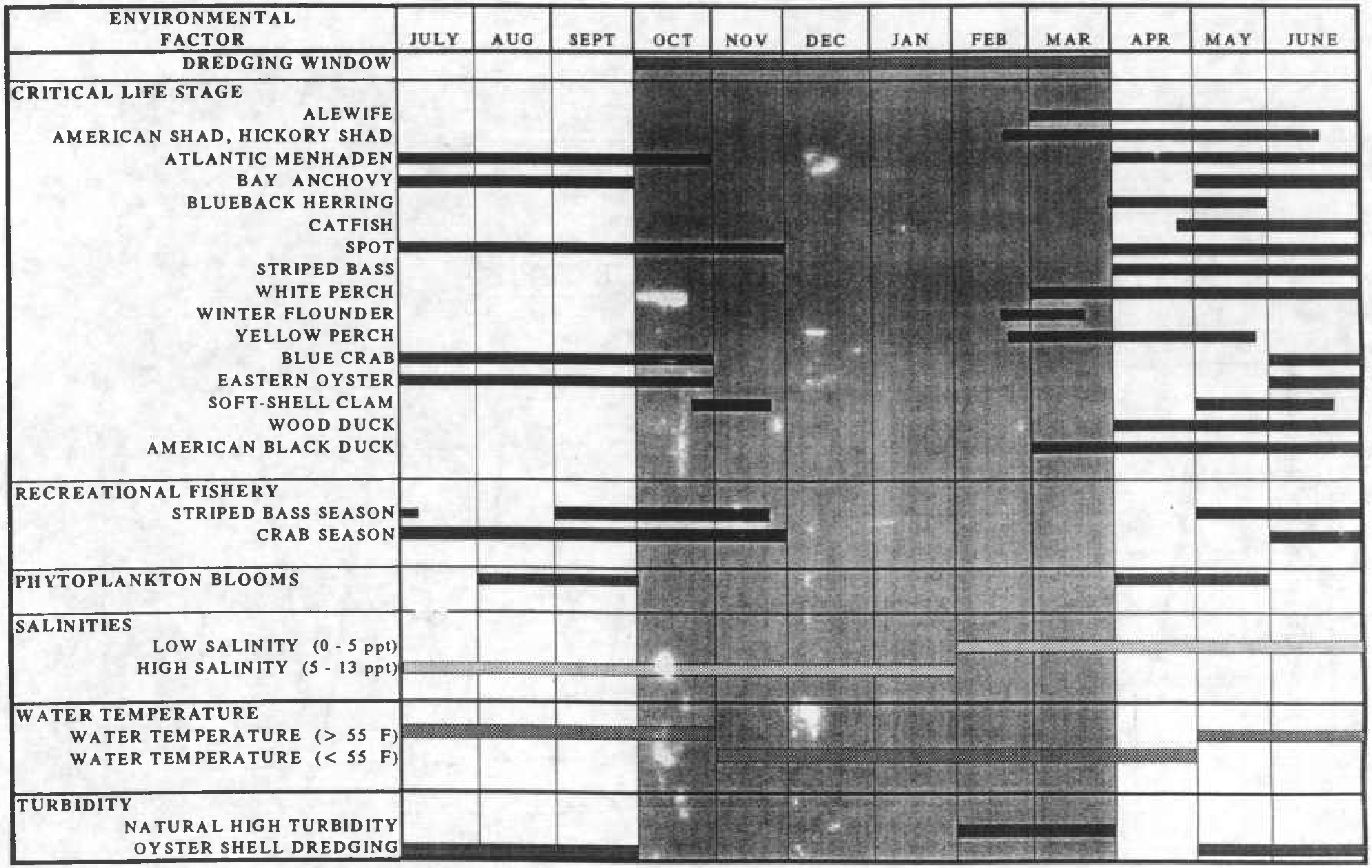


Figure 5-10: Critical Life Stages and Pertinent Environmental Data of Target Species in the Upper Bay Overlaid with the Dredging Operations Window

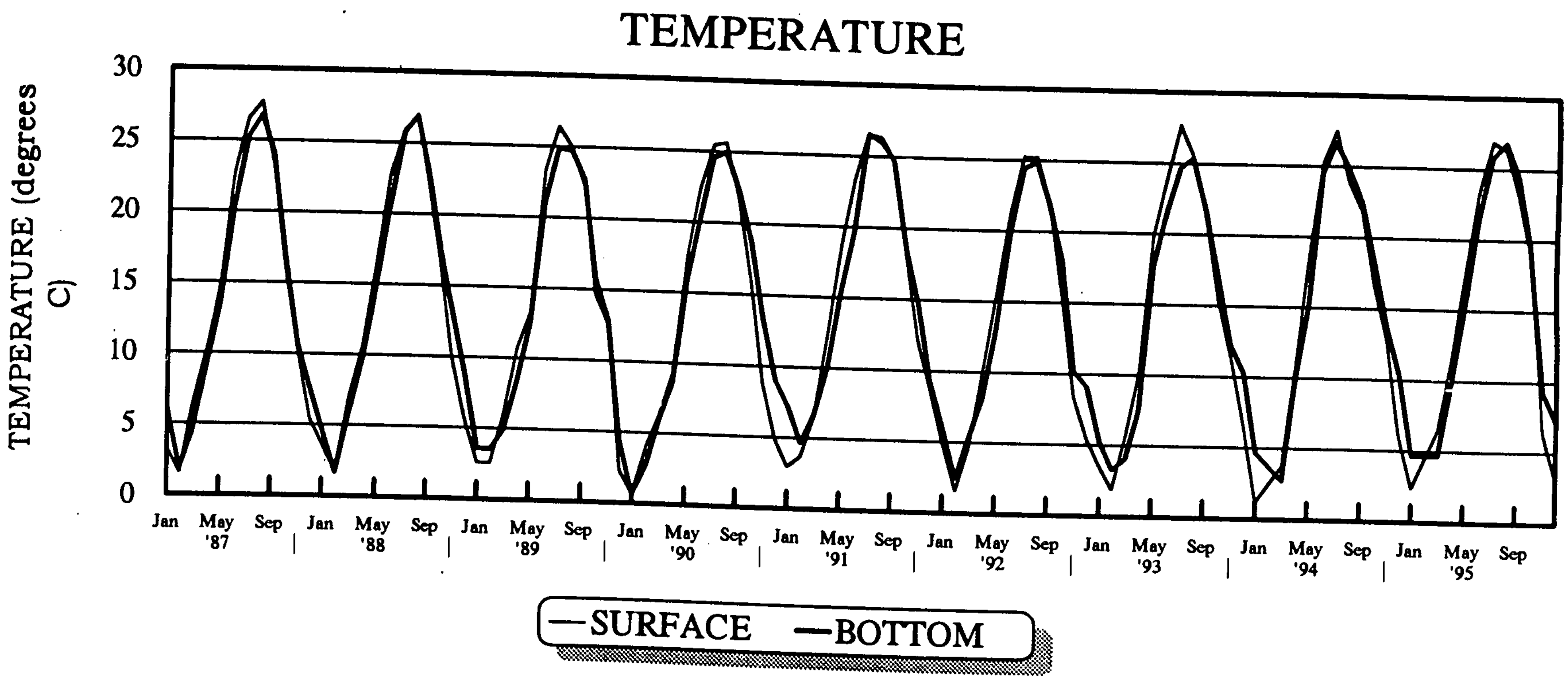


Figure 5-11: Water Quality Data For Pooles Island Area From Water Quality Monitoring Station MCB3.1

Species	Trophic Level	Spawner Location	Life Stage	DO (mg/L)	Temperature (°C)	Salinity (ppt)	Suspended Solids (mg/L)	pH (units)
Alewife	Planktivore	Anadromous	Egg	>5.0	11-28	0-2	<1000	5.0-8.5
			Prolarva	>5.0	8-31	0-3	NIF	5.5-8.5
			Postlarva	>5.0	14-28	0-5	NIF	5.5-8.5
			Early Juvenile	>3.6	10-28	0-5	NIF	NIF
			Adult	>3.6		0-30		
American Shad (Hickory shad req. assumed to be similar)	Planktivore	Anadromous	Egg	>5.0	13.0-26.0	0-15	<1000	>6.0
			Larvae	>5.0	15.5-26.1	NIF[1]	<100	>6.7
			Juvenile	>5.0	15.6-23.9	0-30	<100	NIF
			Adult	>5.0	10-30	0-30	<100	NIF
Atlantic Menhaden	Planktivore	Marine	Egg					
			Larvae					
			Juvenile	1.1=mortality	<33	5-10		
			Adult			3.5		
Bay Anchovy	Planktivore	Estuarine	Egg	>3	13-30	4-20		
			Larvae	>3	15-30	0-15		
			Juvenile	>3	10-30	9-30		
			Adult	>3	8-32	9-30		
Blueback Herring	Planktivore	Anadromous	Egg	NIF	14-26	0-22	<1000	5.7-8.5
			Prolarva	>5	14-26	0-22	<500	6.2-8.5
			Postlarva	>5	14-28	0-22	<500	NIF
			Early Juvenile	>4.0	10-30	0-28	NIF	NIF
Channel Catfish	Omnivorous / Piscivorous	Estuarine	Egg					
			Prolarva					
			Postlarva					
			Early Juvenile					
			Adult		>21.1	19-21		
Spot	Benthic	Marine	Postlarva	>2	6-20	<2	88=mortality	NIF
			Juvenile	>2	6-20	no preference	NIF	NIF
Striped Bass	Carnivore	Anadromous	Egg	>5.0	12-23	0.5-10	<1000	7-9.5
			Prolarva	>5.0	12-23	0.5-10	<100	7-8.5
			Postlarva	>5.0	12-23	1-10.5	<100	7-8.5
			Early Juvenile	>5.0	10-27	0-16		7-9

1 NIF means no information found
2 Data taken from Habitat Requirements for Chesapeake Bay Living Resources, 1991 and Carmichael *et al.*, 1992
3 Blank Spaces = Data Not Available

Table 5-1: Habitat Requirements Of Finfish & Shellfish Target Species In The Upper Bay

Species	Trophic Level	Spawner Location	Life Stage	DO (mg/L)	Temperature (°C)	Salinity (ppt)	Suspended Solids (mg/L)	pH (units)
White Perch	Carnivore	Anadromous	Egg	>5	12-20	0-2	<100	6.5-8.5
			Larvae	>5	12-20	0-2	<500	6.5-8.5
			Juvenile	>5	10-30	0-3	<500	7-9
			Adult	>5	10-30	5-18	<500	NIF
Yellow Perch	Carnivore	Freshwater	Egg	N/A	7-20	0-2	<1000	6-8.5
			Larvae	N/A	10-30	0-2	<500	6-8.5
			Juvenile	>5.0	10-30	0-5	N/A	6-8.5
			Adult	>5.0	6-30	0-13	N/A	6-8.5
Winter Flounder	Benthic	Estuarine	Egg		1-10	11.4-33		
			Larvae		0-25	3.5-27.7		
			Juvenile		0-25	4-30		
			Adult		12-16	>20		
Blue Crab	Omnivorous	Estuarine	Egg					
			Larvae					
			Juvenile					
			Adult	>3.0	5-39	>20(L), 0-30(A)		>7
Eastern Oyster	Planktivore	Estuarine	Egg					
			Larvae					
			Juvenile					
			Adult		1-36	>12		6-10
Soft-shell Clam	Planktivore	Estuarine	Egg					varied
			Larvae			> 5		varied
			Juvenile					varied
			Adult		> -12	4-8		varied

1 NIF means no information found
2 Data taken from Habitat Requirements for Chesapeake Bay Living Resources, 1991 and Carmichael *et al.*, 1992
3 Blank Spaces = Data Not Available

Table 5-1 (cont.): Habitat Requirements Of Finfish & Shellfish Target Species In The Upper Bay

Table 5-2: Description of Potential Effects on Target Species in the Upper Bay in Critical Life Stage During Dredged Material Operations Window

Alewife	Spawning occurs in tributaries and Susquehanna flats area of the Bay. No effect.
American Shad	Freshwater spawners. No effect.
Atlantic Menhaden	Ocean spawners; stable population. No effect.
Blueback Herring	Freshwater and brackish water spawners. No effect.
Spot	Ocean spawners; stable population. No effect.
Yellow Perch	Spawn in tributaries and along shorelines. Turbidity and bottom type in G-East and Site 92 unsuitable for eggs. No effect.
White Perch	Spawns in tributaries, in coarser substrates and lower salinities than found at G-East or Site 92. No effect.
Winter Flounder	Feed in deep waters. Spawn in shallow water during winter (known spawning areas in the upper Bay north of the Bay Bridge include the Patapsco, Sassafras, and Chester Rivers). No effect.
Blue Crab	Spawning and early life stages occur in Virginia waters of Chesapeake Bay. No effect.
Soft-shell Clams	Not currently found at G-East or Site 92. No effect.
Eastern Oysters	Not currently found at G-East or Site 92. No effect.
American Black Duck	Potential nesting areas are located 1500 feet away from proposed activity in G-East and Site 92. No effect.

* Note: Striped bass, and other species, are not discussed in this table because their critical life stages do not overlap with the proposed dredged material operations window.

The irregular bottom features of the northeastern corner of G-South and areas south of G-East have been identified as important habitat for adult fish who overwinter in the Bay. The proposed placement actions in reconfigured G-East and Site 92 have been designed to avoid and minimize any effects on these areas through placement of subaqueous berms in both Site 92 and G-East and bottom release scow placement on the northern and eastern edges of reconfigured G-East. Monitoring of dredged material placement are planned to ensure the precise placement and continued stability of the dredged material in both areas.

5.3.5.1. Shellfish

The placement of dredged material at G-East and Site 92 would cause little to no impact to the blue crab, Eastern oyster and soft-shell clam, and their fisheries. The Pooles Island area provides relatively poor overwintering habitat for the blue crab and winter dredge surveys have found that the Pooles Island area has lower densities of blue crabs compared to the upper Bay as a whole (Gordon, MDNR, pers. comm., Nov., 1996). Live oysters have not been found in recent surveys of the Pooles Island area and the closest oyster bar, that has been harvested in recent years, is the Coal Lumps which is located to the southeast of Pooles Island (Judy, MDNR, pers. comm., Feb 1997). Coal Lumps is approximately 3,000 feet (900 m) from the proposed placement areas; therefore, this oyster bar should not be adversely affected by placement activities. Presently, there is no commercial clamming industry in the Pooles Island area. The Tolchester area is the northernmost point for the commercial harvest of soft shell clams (Judy, MDNR, pers. comm., Feb., 1997). Generally, the northern limit of the soft-shell clam is the Patapsco River (Baker and Mann, 1991). Because of the geographic limitations on commercial soft-shell clam harvesting, the proposed placement of dredged material in G-East and Site 92 should not have a detrimental effect on the soft-shell clam and related fishery.

Because of poor habitat conditions, distances from actively used harvesting locations, and the fact that currently live clam or oyster beds have not been documented in the Pooles Island area, the proposed placement of dredged materials in G-East and Site 92 should have little impact on target shellfish species or their fisheries.

5.3.6. Waterfowl and Colonial Wading Birds

Waterfowl needs focus primarily on nesting, feeding and staging. Pooles Island itself serves these purposes for a variety of waterfowl. Feeding and staging occur mostly in upland areas and shallow water (water less than 14 feet). When complete, average elevations in G-East will be -16 feet (-4.8 m) MLLW and in Site 92, average elevations will be -14 feet (-4.2 m) MLLW. Operations in both areas should not affect waterfowl feeding habits. Nesting areas at Pooles Island are in upland areas and are approximately 3,000-3,500 feet (900-1050 m) from the G-East and Site 92 placement locations. Additionally, nesting activities of most target species are outside the dredging operations window and will not be affected by the actual operation. The exceptions are the American Black Duck, which begins nesting in mid-March, and the Great Blue Heron, which begins nesting in mid-February.

The Black Duck uses only upland areas for nesting and feeds in shallow water. The distance of 3,000 yards (2743 m), which separates the nearest placement operations from areas utilized by Black Ducks, provides a substantial buffer during the short overlap with the duck's nesting season. In regard to the Great Blue Heron rookery on Pooles Island, the WHD stated that, given the proposed configuration of the placement areas, the project should not impact the Great Blue Heron rookery. Should the project plan change and potentially impact the waterbird colonies or directly impact the heron during the mid-February through July nesting period, effects would need to be addressed in accordance with COMAR Statute 8-1801/1806. Activities have been ongoing in the Pooles Island area since the 1960's with no notable effect on the Great Blue Heron rookery.

Due to the placement operations window, the history of placement in the Pooles Island area and the configuration of G-East and Site 92, no effects on the waterfowl colonies in the area are expected.

5.3.7. Raptors

Placement activities at G-East and Site 92 would not impact the Bald Eagle nesting site located on Pooles Island and would occur at a time of year that is prior to hatching of the young and the subsequent rearing activities. Osprey located within the Pooles Island area are outside of the project areas. Dredging operations will occur prior to the typical period during which the osprey arrive in the Chesapeake Bay region and begin nesting and rearing their young (March through July). Therefore, dredging operations would not impact the osprey located in the Pooles Island area.

5.3.8. Threatened and Endangered Species

Coordination with USFWS and MDNR has verified that, other than transient individuals, no threatened or endangered species are documented as occurring in the proposed placement areas or relying on them for habitat needs. Therefore, there will be no impact to threatened or endangered species from dredged material placement in G-East and Site 92. Further coordination is ongoing with NMFS regarding issues related to the shortnose sturgeon. Coordination with NMFS will be resolved prior to placement activities occurring in G-East and Site 92.

5.4. CULTURAL RESOURCES IMPACTS

A remote sensing investigation of the project area was completed by PCOE in 1996 in consultation with the MHT. Following a study methodology prepared by PCOE, the survey utilized magnetometer, side-scan sonar and bathymetric data collection to identify potential shipwreck locations (Dolan Research and Hunter Research, 1996). Two targets exhibiting strong shipwreck characteristics were identified. Target 15:844 is located immediately adjacent to the original northern G-East boundary and Target 27:958 is just inside the western G-South boundary, within Site 92.

Due to environmental considerations, the original G-East's northern boundary has been relocated further south. Therefore, Target 15:844 is no longer in the project area and will not be impacted by proposed placement activities. No further investigations are planned for this target location.

Underwater ground-truthing operations on Target 27:958 will be conducted prior to construction, during the design phase of the project, to determine the nature and extent of the material that is generating this signature. The results of this work will be coordinated with the MHT. In addition, the issues raised in MHT's January 17, 1997 letter will be resolved prior to proposed placement activities (Appendix A). Section 106 coordination with the MHT is ongoing and would be completed prior to construction of the sites.

5.5. SOCIOECONOMIC IMPACTS

There is projected to be a slight increase in noise during dredging activity. An unquanitifiable, slight increase in air pollution is projected as a result of engine exhaust from dredges and from tugs involved in dredged material placement activities, in the event of controlled bottom release scow placement. These activities would have short-term minor impacts that would terminate once placement activities are completed during each dredging season.

Aesthetically, there will be a temporary increase in turbidity during dredging and placement activities. These activities would result in short-term, near-field impacts on water and air quality that would terminate once placement activities are completed during each dredging season.

Throughout the scoping for this EA, the major socioeconomic concern of the resource and regulatory agencies, charter boat captains, and representatives of organized sportfishing interests was the potential impact of placement on the commercial and recreational fisheries in the Pooles Island area. One field study and three data assessments were performed to address this concern. Results of these four studies are summarized below.

The charter boat angling study found that fishing productivity for striped bass in the original G-East site configuration was concentrated in an area of high relief on the northeastern edge of the site. This area constitutes a small portion of the overall acreage of high relief bottom that is used by the local charter boat industry, but the concentration of catches at this location have resulted in this specific area becoming considered important locally for fishing. Thus, the site was reconfigured to exclude this productive area. Site 92 had, by far, the lowest fishing productivity of the four areas fished in this study. Analysis of the NMFS MRFSS data and the MDNR charter boat and commercial data indicated that the proposed placement areas were not unique in their contribution to the commercial and recreational fisheries in the Pooles Island area (Miller and McCracken, 1997). The aerial survey data indicated that the Pooles Island area provided 15.8 percent of the total fishing activity in the sampling area, which included portions of the mid- and upper Bay (MDNR, 1994). By ranking the 9 transects according to percentage by transect, the two transects in the Pooles Island area were ranked sixth and seventh (MDNR, 1994).

It was determined that limiting the elevation of placed material and placement of underwater berms was needed to avoid significant sediment transport of placed materials. Accordingly, both Site 92 and G-East as reconfigured will be designed to prevent sediment transport to nearby high relief areas. This will be achieved by placing subaqueous berms in the southern area of G-East and the northeastern portion of Site 92, and by strategic bottom release scow placement of dredged material along portions of the northern and eastern edges of the reconfigured G-East site to protect the areas to the north and east from sediment transport from the placement area.

Potential impacts to the recreational and commercial fisheries have been minimized or avoided by the reconfiguration of G-East and by the application of appropriate placement and engineering techniques in G-East and Site 92 to prevent potential movement of material into areas of high relief. Specifically, these modifications will avoid changes to the interaction of the high relief area in the northeastern corner of the original G-East site configuration with its ambient environment, thereby avoiding impacts to fishing and associated economic productivity from the placement of dredged material. The site reconfiguration will also avoid interference with the permitted shell mining activity. With these modifications, there are no projected significant socioeconomic impacts associated with dredged material placement at Site 92 and G-East as reconfigured.

5.6. CUMULATIVE ENVIRONMENTAL IMPACTS

Cumulative impacts from this placement action, as well as other actions in the project vicinity, are evaluated and considered in this EA as required by NEPA. In the case of open-water placement, cumulative impacts include such concerns as changes to the physical substrate, changes in water quality, changes in suspended particulates and turbidity levels, water circulation, fluctuation and salinity determinations, contaminant determinations and aquatic ecosystem and organism determinations. Areas of concern also include possible changes in aesthetics, economic impacts to humans and human health impacts. All of these considerations are related directly to aquatic ecosystem effects, and indirectly to human health and economic impacts. Actions considered as possibly contributing to cumulative environmental impacts for the purposes of this EA include impacts from previous, current and projected future open-water placement sites in the Pooles Island area, and ongoing MDNR fossil oyster shell dredging operations which are also conducted in the Pooles Island area.

Previous open-water placement of navigation dredged material has occurred in the upper Bay since 1964 (Halka and Panageotou, 1992). Halka and Panageotou estimated in 1992 that the change in depth in placement areas near Pooles Island represented 17.3 mcy (13.3 mcm) of navigation dredged material which had been placed in areas D, E&F, G-North, G-Central, G-South and Area H since 1964. Since then, an additional 3 to 4 mcy of dredged material has been placed in Area G-West, G-South and Areas E&F. According to Halka and Panageotou (1992), water depth decreases in the placement areas since 1938 represents an additional 4 mcy (3.1 mcm) of sediment accumulated through natural sedimentation processes. Previous to 1960, deepening and maintenance dredged materials were placed by hopper dredge within 1,500 feet (450 m) of the channels. No volume records were kept of this practice; therefore, impacts are difficult to estimate in terms of aerial coverage.

The acreage of each designated open-water placement site has not always been specifically defined. An estimate of the total acreage of past, current and proposed open-water placement areas near Pooles Island used since 1964 is approximately 1915 acres (7,750,005 m^2). Area G-West and proposed Areas G-East and Site 92, which are all confined placement areas, represent 1459 acres (5,904,573 m^2). Areas D, E, F, H, G-North, G-Central, G-Restricted and G-South, which are all unconfined placement areas, represent 456 acres (1,845,432 m^2) of the total. Information on side slope coverage is not available on most dredging jobs; however, based on monitoring studies conducted by Panageotou and Halka (1989) on past unconfined open-water placement activities in areas H and D (which represent 217 acres), it can be roughly estimated that dispersement of deposited material occurred over roughly three to five times the 500-foot width of these two delineated placement sites, at some locations. This dispersement outside the placement area boundaries occurred at the time of discharge. Information on dispersement at other placement sites is unknown, although improved monitoring and placement techniques have minimized the potential for movement of material outside of the designated site boundaries.

Historically, open-water placement in the Pooles Island vicinity was unconfined. However, the current (G-West) and proposed (G-East and Site 92) practice for aquatic placement in the Pooles Island vicinity is to utilize bottom-releasing scows to create berms to confine the deposited sediments in the designated place. Monitoring studies at G-West have shown that the majority of sediments stay in place and while some resuspension occurs, there is no identified "end location". These studies also have shown that adjacent high relief areas have not been impacted by dredged material that has been resuspended or migrated outside the site boundaries.

The acreage of MDNR shell dredging areas includes 1,075 acres (4.4 mcm) which have been dredged since 1960. A total of 10,480 acres (42.4 mcm) could be dredged for the removal of fossil oyster shell if all currently identified sites are permitted and dredged. Current permits allow 4,641 acres (18.8 mcm) to be dredged, of which 885 acres (3.6 mcm) has been dredged to date (Judy, MDNR, pers. comm., Jan. 27, 1997).

5.6.1. Physical Substrate Determination

The substrate types in the areas of Site 92 and G-East are predominantly silty clays. This is the same type of material that is in the channels and is proposed for placement. Therefore, there should be no cumulative negative impacts attributed to changing particle sizes. Use of clamshell dredging techniques results in less bulking of the dredged material, and as in the case of the G-West berm, little change in volume due to consolidation of the material was observed in the first year after placement. Therefore, clamshell dredged sediments are relatively consolidated when they are placed, and are more similar initially to the *in situ* sediments. When hydraulic placement techniques are used, more bulking of the material occurs and a higher percentage of height reduction occurs due to both consolidation and resuspension in the first year after placement. Within one to two years after placement the void ratios and water contents of hydraulically placed sediments achieve background conditions.

Substrate elevations in the project areas will, of course, change due to the placement of dredged material. The actions have been designed to utilize areas that already possess gradual slopes or basins and to avoid changing areas of high relief. Erosion potential of the dredged material is greater in the first year after placement, and severe storm events would have the potential to cause significant resuspension of the placed materials. Modeling studies by the MGS have shown no clear "location" of material resuspended from this area of the bay. The layer of particulates is thought to be so fine that there is no measurable accumulation in any location (Halka and Panageotou, 1993).

Based on the above findings, no cumulative negative impacts from physical substrate changes due to the proposed placement action are anticipated.

5.6.2. Water Circulation, Fluctuation and Salinity Determinations

The plan condition raises the elevations in Site 92 to -14 feet (-4.2 m) MLLW and in G-East to -16 feet (-4.8 m) MLLW, thereby reducing the water depth in these areas. As discussed in Section 5.1.3, no cumulative impacts related to a change in water circulation is expected based upon results of the model runs. Dissolved oxygen levels in the water column and in the surface sediments after dredged material placement in G-West have been found to stay within the ranges found in reference sediments nearby (Boynton *et al.*, 1997). Therefore, no cumulative impacts related to changes in dissolved oxygen level, water circulation, fluctuation or salinity are anticipated due to the proposed placement action.

5.6.3. Suspended Particulate and Turbidity Determinations

Suspended particulate plumes from placement tend to range in concentration depending on the type of placement and the prevailing tide and current conditions. Plumes generally last less than twenty minutes for controlled bottom release scows and are basically in existence continuously during hydraulic placement activities. Placement of dredged material is traditionally accomplished from October 1 to March 31 each year, which limits impacts resulting from temporary increases in suspended particulates and turbidity to the least biologically active months of the year. Increased loads of suspended sediments are present during the summer and fall in the upper Bay due to MDNR fossil oyster shell dredging operations. The dredging, and subsequent washing, of the fossil oyster shell to remove sediment is the chief cause of the turbidity observed during clamshell dredging of the MDNR fossil oyster shell deposit areas. Water quality monitoring of the dredged material placement areas has been performed during time periods when MDNR fossil oyster shell dredging was occurring. Increased turbidity from these activities was noted once, in a progress report in 1995. No long-term changes in the water quality near the MDNR fossil oyster shell dredge areas and the dredged material placement areas have been observed during the G-West water quality monitoring program when compared to reference areas (Dalal, 1996c; Magnien *et al.*, 1993; Romano *et al.*, 1995). Therefore, no cumulative impacts to suspended particulates or turbidity from dredged material placement combined with MDNR fossil oyster shell dredging are anticipated.

5.6.4. Contaminant Determinations

The material dredged from the upper Bay channels has been found to be uncontaminated and similar in quality to the sediments found at the proposed placement sites. Therefore, no cumulative impacts from contaminants are anticipated. Refer to Section 4.2.3 for more detailed information about specific sediment chemical parameters.

5.6.5. Aquatic Ecosystem and Organism Determinations

Impacts to the aquatic ecosystem and individual organisms from use of the proposed placement areas were discussed earlier in this section. Short-term impacts are expected to occur from: increased turbidity in the water column; an increased rate of ammonium released from controlled bottom placed sediments in the first summer after controlled bottom release scow placement; a change in the direction of flux of phosphorus and nitrite/nitrate for at least the first summer after controlled bottom release scow placement; and, smothering of the benthic community from placement and its subsequent recovery, which is estimated to occur within 12 to 18 months after placement activities have ceased in each area. Similar effects are expected to be found at the existing placement sites and in the MDNR fossil oyster shell dredging areas. All of these effects are short-term impacts. Therefore, these short-term impacts are not anticipated to cause cumulative long-term or cumulative negative impacts to the upper Bay ecosystem. Each of the components of aquatic ecosystem impacts are discussed further below.

Turbidity impacts are short-term, lasting minutes for controlled bottom placement and hours to days for hydraulic placement actions and MDNR fossil oyster shell dredging. Minimization of these impacts is attempted by limiting navigation dredging and placement activities to the least biologically active times of year, and through use of plates installed below the surface of the hydraulic pipeline inflow point to decrease erosion and resuspension of bottom sediments. Increased turbidity levels occur naturally in the Pooles Island area because it is located within the turbidity maximum zone of the upper Bay, so the ecosystem in this area has naturally high turbidity and the population dynamics reflect this condition. Cumulatively, no long-term or far-field effects from placement activities and other activities in the Pooles Island area are foreseen.

Cumulative water quality impacts from the proposed placement areas are not projected and the short-term impacts are not projected to be significant. While sediment nutrient flux measurements have found increased rates of release of ammonium in placed sediments during the first summer after placement, phosphorus and nitrite/nitrate have conversely been directed into the sediments for at least one year after placement. As this area of the Bay is generally phosphorus limited for eutrophication, no degradation of water quality in the summer due to the action of disturbing and placing the sediments is expected, and none has been observed in G-West (Dalal, 1996c; Magnien *et al.*, 1993; Romano *et al*, 1995). Water quality studies performed annually during and after placement at the nearby G-West placement area have found no changes in water quality between the placement area and nearby reference areas. No changes in nutrient levels, algal growth or dissolved oxygen have been observed after placement.

Studies of current patterns and water circulation in the project areas have shown that they should not be affected by the decreased depths which would result after placement. Therefore, no cumulative impacts to the aquatic ecosystem from changes in current patterns and water circulation from this placement action are anticipated (see Section 5.1).

Use of the hydrodynamic model has shown no changes in normal water fluctuations in the proposed placement areas (see Section 5.1). Therefore, no cumulative impacts to the aquatic ecosystem from this placement action combined with other activities in the Pooles Island area are anticipated.

Salinity gradients in the area normally reflect a well-mixed water column, with the occasional exceptional year of low freshwater flow, when a pycnocline can be observed in the waters of Site 92 and near G-East. The placement of dredged material in the project area will not significantly block or impede flow, therefore no change in the salinity gradient is expected due to dredging and placement activities in these areas. No cumulative impacts to the aquatic ecosystem from changes in salinity gradient due to this placement action are anticipated.

No rare, threatened or endangered species are recorded as occurring in this area of the Bay, with the exception of the shortnosed sturgeon, which has been caught in nearby areas, probably in transit from or to the C&D Canal. The placement action is not foreseen to cause any cumulative negative impact to the shortnosed sturgeon. Coordination with NMFS is ongoing on this issue.

There would be two types of short-term negative impacts to fish and benthic aquatic organisms related to placement actions. First, fish would avoid swimming through the area during times of high turbidity, and sight feeders, such as the striped bass and white perch would most likely not feed in the placement area and MDNR fossil dredge area during placement actions. Second, benthic organisms would be smothered in the placement areas as they were covered with dredged material. This would in turn reduce the area that bottom feeding organisms, such as hogchokers, would have available to feed until the community had recovered. The turbidity impacts are short-term and occur during placement and dredging activities. The benthic impacts have been found to last between 12 and 18 months after placement, at which point the benthic community returns to a population which is characteristic of the region in terms of species abundance and composition.

Actions taken to minimize aquatic organism impacts from navigation dredging and placement operations are: to place during the time of the year when the fish are not feeding as actively and overall ecosystem productivity is low; to avoid placing material when spawning seasons occur; and to limit the area where placement occurs to defined, permitted geographical areas. Studies of fish abundance, size and species composition in the G-West placement area before, during and after placement have found no statistically significant changes in any of these factors. Therefore, no cumulative impacts to the fish populations related to dredging and placement activities are anticipated.

5.6.6. Human Recreational and Economic Use

The primary recreational and economic interest in this area of the upper Bay is the striped bass fishery. Fishing activity studies performed for this EA have found that the two project sites are relatively unproductive from the standpoint of average CPUE over each project area, when compared to nearby reference areas. Fish abundance, size and species composition studies which have covered this area, as well as Area G-West, have found no significant differences in the numbers or types of fish species in G-East or Site 92 when compared to nearby reference areas. However, further study of the catch data in G-East showed one area of high relief within the northeastern portion of the site which exhibited a high relative catch rate. This small area was where 84% of the striped bass were caught within the G-East boundary. This indicates that overall, G-East shows similar abundances to nearby areas and below average catches, but this particular area of G-East has some significance, potentially in terms of the feeding behavior of the fish.

Based on the results of the angling study, this area within G-East was eliminated from the project boundaries in order to minimize potential impacts to recreational, charter boat and commercial fisheries. Controlled bottom placement of dredged material within the G-East area should keep dredged material out of adjacent high relief areas. With the exclusion of this area from the project, no cumulative negative impacts to human recreational and economic use are anticipated from this placement action.

5.6.7. Cumulative Impacts of Nutrient Releases and the Efforts of the Signatories of the Chesapeake Bay Agreement

In 1983, the first Chesapeake Bay Agreement was signed by several federal agencies, Washington DC, and the three states in close proximity to the Bay and its tributaries - Maryland, Pennsylvania and Virginia. The 1987 renewal of this agreement, among other things, set a goal of 40% reduction of nutrients entering the Bay by the year 2000. The agreement was signed again in 1994, and committed to extending the work towards achieving these goals past the year 2000. The 1995 annual report on the state of the bay (Magnien *et al.*, 1995) discusses overall nutrient sources and reduction goals. The two most significant nutrients which threaten the Chesapeake Bay are nitrogen and phosphorus. The sources of nitrogen and phosphorus have been estimated to include agricultural sources, forests, point sources, the atmosphere and development. The two largest contributors of both nitrogen and phosphorus are agriculture and point sources, based on 1985 estimates (Magnien *et al.*, 1995). Nitrogen and phosphorus are the food source for algae blooms which cloud the water, resulting in decreased light penetration and the destruction of SAV beds. Algae blooms also consume oxygen, and when low oxygen levels occur, fish and other living resource can not survive.

Mathematical modeling of the Chesapeake Bay system has shown that the tributaries, including the Potomac River and those north of the Potomac, do have a far greater effect than the more southern tributaries on the status of the dissolved oxygen in the Bay. The progress so far in cleaning up point and non-point sources has yet to be consistently measured in a reduction in the low dissolved oxygen levels in some areas of the Bay. The is thought to be due to the load of nutrients or 'nutrient bank' which exists in the sediments. These sediment nutrients are available to the water column and until the surface layers of sediment also become depleted in nutrients, a consistent reduction in low dissolved oxygen levels may not be achieved.

Sediment nutrient fluxes have therefore been studied since 1993 as part of the annual monitoring of the open-water placement of dredged material at Area G-West. Previous to this, some sediment nutrient flux studies were also performed in Pooles Island G-Central Area in 1992 and 1993. Findings of these studies have found that the dredging and open-water placement of sediments does, in fact, change the dynamics of nutrient release from the placed sediments.

Boynton *et al.* (1997) have made the following determinations from three years of study of the releases of nutrients from placed navigation dredged material:

- Ammonium fluxes are significantly higher in the first summer after controlled bottom release placement of dredged material in the upper Bay (as compared to nearby reference areas). The net increase in ammonium on a regional basis is defined as modest and significant on a local basis, but insignificant on a regional basis. The net increase in ammonium to the system is equated to a 0.01% increase in annual nitrogen input to the upper Bay from the Susquehanna River, which is the primary source of nutrient inputs to this area of the Bay. Ammonium flux rates from hydraulic placement techniques have not been observed to change significantly when compared to background levels.

- Phosphorus fluxes are transformed from net small positive inputs from the sediment to a net negative flux, with phosphorus stripped from the water column by the sediments when controlled bottom placement techniques are used. This is thought to be due to the oxidized, flocculating, fine-grained nature of the sediments, which provides a higher tendency to bind phosphorus than undisturbed sediments in the area. Phosphorus fluxes in the reference areas are low when compared to other areas of the Bay, so the change in flux rates is not determined to be significant in terms of resulting changes in water quality. Hydraulic placement has not resulted in the same negative fluxes, and no significant change in phosphorus flux rates has been observed using this placement technique.

- Nitrite/nitrate fluxes in the dredged material placement area also have been observed to change from a net small positive flux from the sediments to the water column to a negative flux, with nitrite/nitrate stripped from the water column to the placement area for at least two summers after controlled bottom release placement techniques. This is thought to result in a net loss in nitrogen from the system as the nitrite/nitrates are denitrified and lost to the atmosphere as nitrogen gas. This loss is determined to be small to modest in terms of overall nitrogen dynamics in this area of the Bay. The use of hydraulic placement techniques results in smaller fluxes of nitrite/nitrate from the sediments. These small fluxes have been observed to be either net negative or net positive, but overall are not significantly different from nearby undisturbed reference areas.

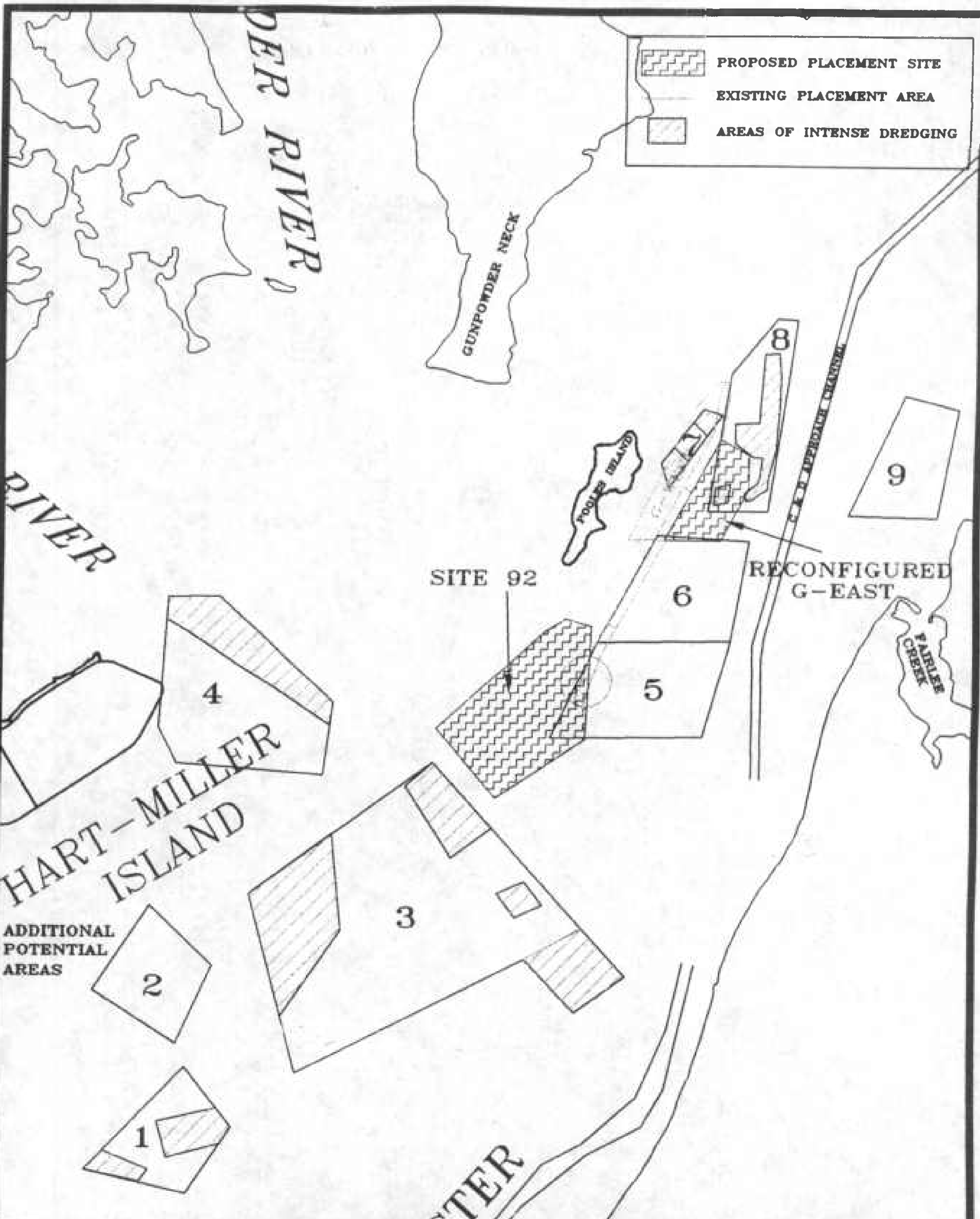
Cumulatively, impacts from the placement actions on the Chesapeake Bay Agreement nutrient reduction goals are anticipated to be minimal. While it is true that some increased releases of ammonium from the placement area will occur for one summer season after placement, the amount of nitrogen being released is insignificant compared to annual loads. In addition, the volume of surface area over which the sediments were releasing nutrients in the channel is reduced by placing the material in thicker lifts over a smaller surface area in the placement area. The depth thought to be biologically active for nutrient releases is equal to the top 5 centimeters of sediment (Boynton *et al.*, 1992). When the sediments are removed from the channel, they are deposited in a smaller acreage than they covered in the channel. Therefore, a small area of release should result. When this is combined with the lack of local or regional observed impacts to water quality and the mitigation of impacts due to the timing of placement, no cumulative impacts related to the nutrient reduction goals of the Chesapeake Bay Agreement are anticipated.

5.6.8. Fossil Oyster Shell Dredging and Dredged Material Placement Coordination

MDNR was contacted in January, 1997 to obtain information regarding their fossil oyster shell dredging program (Judy, MDNR, pers. comm., Jan. 27, 1997). The first recorded activity the MDNR fossil oyster shell dredging program in the upper Bay was in 1960. The current estimate for the total acreage dredged since 1960 is 1,075 acres. Currently there are three areas permitted, 3(A) (3,673 acres), 8(D) (550 acres), and 9(F) (418 acres). The numbers designate the sites as presented in Figure 5-11 (MES); the letters designate the sites as labeled on MDNR's permits. Site 3 is located southeast of HMI, south of Pooles Island, and west of the channel. Sites 8 and 9 are located in the Pooles Island area. Site 8 overlaps with a portion of G-East and site 9 is located east of the channel of the mouth of Fairlee Creek. To date, approximately 885 acres within the three areas have been dredged (70 acres in Site 8, 5 acres in Site 9, and 810 acres in Site 3).

There are six previously permitted areas in the upper Bay. The current estimates are: Site 7(E) totals 100 acres (404,700 m^3), 8 acres (32,376 m^3) were dredged; Site 4 (old D) totals 579 acres (2.3 mcm), 135 acres (546,345 m^3) were dredged; Site 2(C) totals 464 acres (1.9 mcm), 0 acres (0 m) were dredged; Site 1(B) totals 483 acres (2 mcm), 47 acres (190,209 m^3) were dredged; and Site 5 totals 685 acres (2.8 mcm) and Site 6 totals 528 (2.2 mcm), it is unknown how many acres were dredged in sites 5 and 6. These sites could be repermitted in the future and utilized for fossil oyster shell dredging.

Coordination of shell dredging activity for this action has included several meetings with the MDNR, the MPA, the PCOE and the MES. The area in which conflicts are observed is the MDNR Area 8, which partially overlaps with G-East. The MDNR permit currently allows fossil shell dredging in this area through 1998. Because a portion of this area was removed from the boundaries of the proposed placement area after observing the findings of the fishing activity study, the overlap is reduced to approximately 14 acres within the intense dredging area and 126 acres overall (including the 14 acres within the intense dredging area). In addition, new dredging equipment, which will allow removal of the fossil shell material down to 50 feet below the surface, should allow removal of all shell in this area by the 1998 current permit expiration. Furthermore, MDNR activities are performed in the spring and summer, in order to match cultch removal with spat set periods. Navigation dredging activities, conversely, occur in the fall and winter. Therefore, due to the absence of a temporal overlap of dredging schedules, and removal of the high relief area from the navigation dredged material placement area, conflicts are avoided and cumulative impacts to water quality are not anticipated to occur as a result of these independent dredging activities.



MARYLAND PORT ADMINISTRATION

MARYLAND ENVIRONMENTAL SERVICE

US Army Corps of Engineers

MDNR FOSSIL OYSTER SHELL DREDGING AREAS
FIGURE 5-12

6. RELATIONSHIP OF THE PROPOSED ACTION TO OTHER ENVIRONMENTAL STATUTES & REGULATIONS

Clean Air Act (42 USC 7401 *et seq.*)		Not applicable
Clean Water Act (33 USC 1251 *et seq.*)		
§301(h)	Effluent Limitations	Not Applicable
§311	Oil and Hazardous Substances Liability	Not Applicable
§402	NPDES	Not Applicable
§403	Ocean Discharge Criteria	Not Applicable
§404	(see Section 7 of this document)	Full Compliance
Coastal Zone Management Act (16 USC 1456)		Full compliance upon receipt of WQC.
Endangered Species Act (50 CFR 17.11-17.12)		Full compliance
EO 11990, Protection of Wetlands		Not applicable
Fish and Wildlife Coordination Act (16 USC 662)		Full compliance
Marine Protection Research and Sanctuaries Act (33 USC 1401 *et seq.*)		Not Applicable
National Environmental Policy Act (42 USC 4321 *et seq.*)		Full compliance
National Estuary Program (33 USC 1330 Sec. 320)		Full compliance
National Historic Preservation Act (16 USC 470)		Full compliance upon verification of targets.
River and Harbor Act (33 USC 401 *et seq.*)		Full compliance

7. SECTION 404(B) 1(1) EVALUATION

7.1. G-EAST DREDGED MATERIAL PLACEMENT SITE

7.1.1. Project Description

A. **Location**: The proposed G-East open-water dredged material placement site is located near Pooles Island in the upper Chesapeake Bay. It is east of G-Central and G-North and west of the C&D Canal approach channel.

B. **General Description**: Construction and use of the G-East open-water dredged material placement site.

C. **Authority and Purpose**: The Governor's Task Force and the DNPOP participants researched and made recommendations regarding the management of dredged material as part of ensuring the continued vitality of the Port. The G-East site was recommended as an interim measure for providing dredged material placement capacity for the C&D Canal northern approach channels.

D. **General Description of Dredged Material:**

1. General Characteristics: Predominantly fine grained silts and clays.
2. Quantity of Material: approximately 1.2 mcy.
   a. Initial Construction: up to 300,000 cy for berm and 400,000 cy for bottom release scow placement.
   b. Maintenance Dredging: 1.2 mcy including berm and bottom release scow placement areas.
3. Source of Material: Grove Point to Tolchester Reach of the C&D Canal northern approach channels.

E. **Description of Proposed Discharge Site:**

1. Location: See figures 1-1, 1-2, 1-3 and 3-3 of this document.
2. Size: Approximately 281 acres.
3. Type of Site: Estuarine, open water.
4. Type of Habitat: Estuarine, open water.
5. Timing and Duration of Discharge: Berm construction and bottom release scow placement to avoid material transport would occur one season prior to use of the site for hydraulic or bottom release scow placement. It is estimated that the site would reach capacity in the first full placement season.

F. **Description of Disposal Method**: The berm would be constructed utilizing bottom release scow placement techniques using dredged material. Subsequent to construction, material would be placed in the site utilizing either hydraulic or bottom release scow placement techniques.

7.1.2. Factual Determinations

A. **Physical Substrate Determinations:**

1. Substrate Elevation and Slope: The site would have a final elevation of -16 feet MLLW and side slopes up to 30H:1V.
2. Sediment Type: Fine grained silts and clays.
3. Dredged Material Movement: The berm would restrict the movement of dredged material into areas south of the site. Bottom release scow placement along portions of the reconfigured northern boundary and along portions of the eastern boundary would prevent movement east and north of the area. The site would be filled to -16 ft MLLW to maintain a relatively flat fill line (without mounding) and would tie into existing elevations. This would minimize the potential for sediment transport and erosion.
4. Physical Effects on Benthos: Some loss of benthic organisms as a result of dredged material placement and some temporary migration of fish population from placement area. Research has shown that benthic communities recover within 12 to 18 months.
5. Actions taken to Minimize Impacts: Seasonal placement restrictions to avoid impacts during the spring and summer. Creation of berm and strategic bottom release scow placement to restrict material movement. The site would be filled to tie into existing elevations (without mounding) thus minimizing the potential for sediment transport and erosion.

B. **Water Circulation, Fluctuation and Salinity Determinations:**

1. Water:
   a. Salinity: No effect.
   b. Temperature: Varies with season; normal for upper Bay region; no impact from placement.
   c. Water Chemistry: No effect.
   d. Color: Short-term change due to increased turbidity.
   e. Odor: No effect.
   f. Taste: No effect.
   g. Dissolved Gas Levels: Potential reduction in sediment oxygen demand levels for at least 8 months after placement.

h. Nutrients: Potential changes in sediment nutrient flux rates for at least 8 months after placement. Potential short-term increase in nutrient levels during placement.
i. Eutrophication: Due to well mixed nature of water column and normally low primary productivity in this area of the Bay, especially during the winter placement window, the impacts are expected to be minimal.

2. Current Patterns: No effect.
3. Circulation Patterns: No effect.
4. Water Fluctuations: No effect.

C. **Suspended Particulate/Turbidity Determinations:**

1. Expected Changes in Suspended Particulates and Turbidity Levels in the vicinity of the Disposal Site: Short-term increase in turbidity during placement of dredged material.
2. Effects (degree and duration) on Chemical and Physical Properties of the Water Column:
   a. Light Penetration: Short-term degradation due to increased turbidity.
   b. Dissolved Oxygen: Potential short-term decrease.
   c. Toxic Metals and Organics: No effect.
   d. Pathogens: No effect.
   e. Aesthetics: Short-term degradation during placement activities.
   f. Nutrients: Possible short-term change in dissolved nutrients from placement; increase in sediment oxygen demand and positive flux of ammonium; change from a positive flux of phosphate and nitrate/nitrite into the water column to a negative flux. Possibly lasting through the first summer following each placement action.
3. Effects on Biota:
   a. Primary Production, Photosynthesis: Possible increased nutrient concentrations in suspended particulates at the time of placement.
   b. Suspension/Filter Feeders: Minor and short-term effect due to increased turbidity at the time of placement. Some benthic organisms would be lost through burial.
   c. Sight Feeders: Minor and short-term effect due to increased turbidity at the time of placement.
4. Actions Taken to Minimize Impacts: Seasonal placement restrictions to avoid impacts during the productive spring and summer seasons. Creation of berm and strategic bottom release scow placement to restrict material movement. Filling site to tie into existing elevations (without mounding) thus minimizing the potential for sediment

transport and erosion. Removal of high relief area from northeastern portion of site which was determined to be productive fishing area for striped bass.

D. Contaminant Determinations: The following information has been considered in evaluating the ecological significance of possible contaminants in the dredged material.

1. Physical characteristics of sediments: Clean, channel material.
2. Hydrography in relation to known or anticipated source contaminants: No effect.
3. Results of chemical testing of material in the project area: No effect.
4. Existing water quality conditions in the vicinity of the site: Short-term, near-field impact from placement.
5. Mixing and dilution by tidal action: No effect.
6. Surface water or groundwater quality: No effect.

E. Aquatic Ecosystem and Organism Determinations:

1. Effects on Plankton: Minor and short-term effect.
2. Effects on Benthos: Some existing benthic organisms will be buried during placement of dredged material. Recovery of benthos anticipated within 12 to 18 months.
3. Effects on Nekton: Minor and short-term effect. Fisheries habitat is anticipated to change from waters of a maximum depth of 20-25 feet to waters of 16 feet. The impact of this change is not anticipated to be negative, as there are no known benefits to waters of 20-25 feet versus waters of 16 feet. Area from original G-East configuration that included high relief has been excluded from the placement area.
4. Effects on Aquatic Food Web: No measurable change.
5. Effects on Special Aquatic Sites: None.
6. Threatened and Endangered Species: No effect expected. Coordination with NMFS concerning the status of the shortnose sturgeon in the upper Chesapeake Bay is on-going.
7. Other Wildlife: No effect.
8. Actions to Minimize Impacts: Seasonal placement restrictions to avoid impacts during the spring and summer. Creation of berm and strategic bottom release scow placement to restrict material movement. Filling site to tie into existing elevations (without mounding) thus minimizing the potential for sediment transport and erosion. Removal of high relief area from northeastern portion of site which was determined to be productive fishing area for striped bass.

F. **Proposed Disposal Site Determinations:**

1. Mixing Zone Determinations: The following factors have been considered in evaluating the disposal site:
   a. Depth of water.
   b. Current velocity, direction, and variability at disposal site.
   c. Degree of turbulence.
   d. Rate of discharge.

   An evaluation of the above factors indicates that the location of the disposal site within the mixing zone is acceptable.
2. Determination of Compliance with Applicable Water Quality Certification will be obtained and the project will be in compliance with applicable water quality standards.
3. Potential Effects on Human Use Characteristics:
   a. Recreational Fisheries: Short-term effect.
   b. Water Related Recreation: Short-term effect.
   c. Aesthetics: Short-term effect.
   d. Parks, National and Historic Monuments, National Seashores, Wilderness Areas, etc.: No effect. No targets found within reconfigured site boundary.

G. **Determination of Cumulative Effects on the Aquatic Ecosystem**: No effect (Refer to Section 5.7).

H. **Determination of Secondary Effects on the Aquatic Ecosystem**: Any secondary effects would be minor and of short duration.

7.1.3. Findings of Compliance

A. No significant adaptations of the guidelines were made relative to this evaluation.

B. The proposed placement site is found to have no significant adverse environmental impacts. The no action alternative has adverse impacts on the local economy.

C. The planned placement of dredged material will not violate any applicable State water quality standards. The State of Maryland will provide Water Quality Certification for this project. The disposal operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

D. Use of the selected placement site as proposed is not anticipated to harm any endangered species or their critical habitat. Coordination with NMFS concerning the status of the shortnose sturgeon is on-going.

E. The placement of dredged material as proposed will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish shellfish, wildlife, and special aquatic sites. There will only be short-term, near field effects on the life stages of aquatic life and other wildlife. Therefore, they will not be adversely affected in the long-term. Significant long-term effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values will not occur.

F. Appropriate steps to minimize potential adverse impacts of the discharge on aquatic systems include: scheduling the dredging and placement activities to avoid the spring and summer seasons; creation of a berm and strategic bottom release scow placement to avoid material movement; filling the site to tie into existing contours to avoid potential sediment transport and erosion; and reconfiguration of the site to avoid an area of high relief that was deemed a productive fishing area for striped bass.

7.2. SITE 92 DREDGED MATERIAL PLACEMENT SITE

7.2.1. Project Description

A. **Location**: The proposed Site 92 open-water dredged material placement site is located near Pooles Island in the upper Chesapeake Bay. It is southeast of G-Central, encompasses a portion of existing placement area G-South and is west of the C&D Canal approach channel.

B. **General Description**: Construction and use of the Site 92 open-water dredged material placement site.

C. **Authority and Purpose**: The Governor's Task Force and the DNPOP participants researched and made recommendations regarding the management of dredged material as part of ensuring the continued vitality of the Port. Site 92 was recommended as an interim measure for providing dredged material placement capacity for the southern portion of the C&D approach channel.

D. **General Description of Dredged Material**:

1. General Characteristics: Predominantly fine grained silts and clays.
2. Quantity of Material: approximately 3.7 mcy.
    a. Initial Construction: up to 300,000 cy for berm.
    b. Maintenance Dredging: approximately 3.7 mcy of material including berm creation.
3. Source of Material: Grove Point to Tolchester Reach of the C&D Canal northern approach channels.

E. **Description of Proposed Discharge Site:**

1. Location: See figures 1-1, 1-2, 1-3, and 3-4 in this document.
2. Size: Approximately 934 acres.
3. Type of Site: Estuarine, open water.
4. Type of Habitat: Estuarine, open water.
5. Timing and Duration of Discharge: Berm construction would occur during the October to March, 1997/1998 or 1998/1999 placement window. Placement of dredged material would occur annually between 1997/1998 or 1998/1999 and 2000/2001 or 2001/2002. It is estimated that the site would reach capacity in 2001 or 2002.

F. **Description of Disposal Method:** The berm would be constructed utilizing bottom release scow placement techniques with dredged material or suitable alternate materials. Subsequent to berm construction, hydraulic or bottom release scow placement would occur.

7.2.2. Factual Determinations

A. **Physical Substrate Determinations:**

1. Substrate Elevation and Slope: The site would have a final elevation of -14 feet MLLW and side slopes up to 30H:1V.
2. Sediment Type: Fine grained silts and clays.
3. Dredged Material Movement: The berm would restrict the movement of dredged material into areas northeast of the site. The site would be filled to -14 ft MLLW to maintain a relatively flat fill line (without mounding) and would tie into existing contours. This would minimize the potential for sediment transport and erosion.
4. Physical Effects on Benthos: Some loss of benthic organisms as a result of dredged material placement and some temporary migration of fish population from placement area. Research has shown that benthic communities recover within 12 to 18 months.
5. Actions Taken to Minimize Impacts: Seasonal placement restrictions to avoid impacts during the spring and summer and creation of a berm to restrict material movement. The site would be filled to tie into existing elevations (without mounding) thus minimizing the potential for sediment transport and erosion.

B. **Water Circulation, Fluctuation and Salinity Determinations:**

1. Water:
   a. Salinity: No effect.
   b. Temperature: Varies with season; normal for upper Bay region; no impact from placement.
   c. Water Chemistry: No effect.
   d. Color: Short-term change due to increased turbidity.
   e. Odor: No effect.
   f. Taste: No effect.
   g. Dissolved Gas Levels: Potential reduction in sediment oxygen demand levels for at least 8 months after placement.
   h. Nutrients: Potential changes in sediment nutrient flux rates for at least 8 months after placement. Potential short-term increase in nutrient levels during placement.

i. Eutrophication: Due to well mixed nature of water column and normally low primary productivity in this area of the Bay, especially during the winter placement window, the impacts are expected to be minimal.

2. Current Patterns: No effect.
3. Circulation Patterns: No effect.
4. Water Fluctuations: No effect.

C. **Suspended Particulate/Turbidity Determinations:**

1. Expected Changes in Suspended Particulates and Turbidity Levels in the vicinity of the Disposal Site: Short-term increase in turbidity during placement of dredged material.
2. Effects (degree and duration) on Chemical and Physical Properties of the Water Column:
   a. Light Penetration: Short-term degradation due to increased turbidity.
   b. Dissolved Oxygen: Potential short-term decrease.
   c. Toxic Metals and Organics: No effect.
   d. Pathogens: No effect.
   e. Aesthetics: Short-term degradation.
   f. Nutrients: Possible short-term change in dissolved nutrients from placement; increase in sediment oxygen demand and positive flux of ammonium; change from a positive flux of phosphate and nitrate/nitrite into the water column to a negative flux. Possibly lasting through the first summer following each placement action.
3. Effects on Biota:
   a. Primary Production, Photosynthesis: Possible increased nutrient concentrations in suspended particulates at the time of placement.
   b. Suspension/Filter Feeders: Minor and short-term effect due to increased turbidity at the time of placement. Some organisms would be lost through burial.
   c. Sight Feeders: Minor and short-term effect due to increased turbidity at the time of placement.
4. Actions Taken to Minimize Impacts: Seasonal placement restrictions to avoid impacts during the productive spring and summer seasons and creation of a berm to restrict material movement. The site would be filled to tie into existing elevations (without mounding) thus minimizing the potential for sediment transport and erosion.

D. **Contaminant Determinations**: The following information has been considered in evaluating the ecological significance of possible contaminants in the dredged material.

1. Physical characteristics of sediments: Clean, channel material.
2. Hydrography in relation to known or anticipated source contaminants: No effect.
3. Results of chemical testing of material in the project area: No effect.
4. Existing water quality conditions in the vicinity of the site: Short-term, near-field impact from placement.
5. Mixing and dilution by tidal action: No effect.
6. Surface water or groundwater quality: No effect.

E. Aquatic Ecosystem and Organism Determinations:

1. Effects on Plankton: Minor and short-term effect.
2. Effects on Benthos: Some existing benthic organisms will be buried during placement of dredged material. Recovery of benthos anticipated within 12 to 18 months.
3. Effects on Nekton: Minor and short-term effect. Fisheries habitat is anticipated to change from waters of a maximum depth of 20-25 feet to waters of 14 feet. The impact of this change is not anticipated to be negative, as there are no known benefits to waters of 20-25 feet versus waters of 14 feet.
4. Effects on Aquatic Food Web: No measurable change.
5. Effects on Special Aquatic Sites: None.
6. Threatened and Endangered Species: No effect expected. Coordination with NMFS concerning the status of the shortnose sturgeon in the upper Chesapeake Bay is on-going.
7. Other Wildlife: No effect.
8. Actions to Minimize Impacts: Seasonal placement restrictions to avoid impacts during the spring and summer and creation of a berm to restrict material movement. The site would be filled to tie into existing elevations (without mounding) thus minimizing the potential for sediment transport and erosion.

F. Proposed Disposal Site Determinations:

1. Mixing Zone Determinations: The following factors have been considered in evaluating the disposal site:
   a. Depth of water.
   b. Current velocity, direction, and variability at disposal site.
   c. Degree of turbulence.
   d. Rate of discharge.

   An evaluation of the above factors indicates that the location of the disposal site within the mixing zone is acceptable.

2. Determination of Compliance with Applicable Water Quality Certification will be obtained and the project will be in compliance with applicable water quality standards.
3. Potential Effects on Human Use Characteristics:
   a. Recreational Fisheries: Short-term effect.
   b. Water Related Recreation: Short-term effect.
   c. Aesthetics: Short-term effect.
   d. Parks, National and Historic Monuments, National Seashores, Wilderness Areas, etc.: Coordination is on-going with SHPO. One remote sensing target will be dived on prior to project implementation.

G. **Determination of Cumulative Effects on the Aquatic Ecosystem:** No effects (Refer to Section 5.7).

H. **Determination of Secondary Effects on the Aquatic Ecosystem**: Any secondary effects would be minor and of short duration.

7.2.3. Findings of Compliance

A. No significant adaptations of the guidelines were made relative to this evaluation.

B. The proposed placement site is found to have no significant adverse environmental impacts. The no action alternative has adverse impacts on the local economy.

C. The planned placement of dredged material will not violate any applicable State water quality standards. The State of Maryland will provide Water Quality Certification for this project. The disposal operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

D. Use of the selected placement site as proposed will not harm any endangered species or their critical habitat. Coordination with NMFS concerning the status of the shortnose sturgeon is on-going.

E. The placement of dredged material as proposed will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish shellfish, wildlife, and special aquatic sites. There will only be short-term, near field effects on the life stages of aquatic life and other wildlife. Therefore, they will not be adversely affected in the long-term. Significant long-term effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values will not occur.

F. Appropriate steps to minimize potential adverse impacts of the discharge on aquatic systems include scheduling the dredging and placement activities to avoid the spring and summer seasons and creation of a berm to restrict material movement. The site would be filled to tie into existing elevations (without mounding) thus minimizing the potential for sediment transport and erosion.

G. On the basis of the guidelines, the proposed use of Site 92 for the placement of dredged material is specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects on the aquatic ecosystem.

8. COORDINATION

The Pooles Island Placement Sites were recognized as an essential element for the continued viability of the Port of Baltimore by the Governor's Task Force and the DNPOP program. Diverse representation is necessary to achieve a consensus on issues that often must address a number of conflicting interests. Specifically, in this case, the maintenance of shipping channels and preservation of ecological quality in the upper Bay. DNPOP recommendations include the continued use of the existing Pooles Island placement sites, continuing environmental monitoring such as the comprehensive monitoring that has been on-going in conjunction with placement operations in G-West, and establishing monitoring plans for future placement sites.

G-East and Site 92 have been the subject of continued review at various meetings associated with the DNPOP program, including the Upper Bay Working Group meetings. Working group participants include representatives from Federal, State and local resource and regulatory agencies, Chesapeake Bay commercial and sport fisher groups, representatives from universities and private and community groups. The Upper Bay Working Group meetings entailed discussions of environmental, engineering, social and economic issues pertinent to development of the G-East and Site 92 concepts and preparation of the EA. Working group meetings were held on March 8, 1996, April 4, 1996, October 3, 1996, December 10, 1996 and February 5, 1997. In addition, three separate meetings regarding fisheries issues were held in August, 1996. Meeting summaries from the working group meetings are included in Appendix A.

Combined with the working group and fisheries meetings, coordination was conducted with the appropriate Federal and State resource and regulatory agencies, universities, and private and community groups regarding specific environmental, economic and social issues. Resource and regulatory agencies contacted include APG, CENAB, UMCEES, Cecil County, EPA, MDE, MDNR, MHT, MGS, MPA, NMFS, NOAA, CENAP and USFWS. Private and community groups contacted include the Alliance for the Chesapeake Bay, CBF, Maryland Waterman's Association, MCBA, Mid-Atlantic Fisheries Council, MSSA, the University of Maryland and the Upper Bay Charter Boat Association. Harford County was contacted but no response was received. Coordination letters received from resource agencies concerning issues pertinent to the preparation of this EA have also been included in Appendix A.

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APPENDIX A

COORDINATION
AND
MEETING SUMMARIES

TABLE OF CONTENTS

FEDERAL, STATE AND LOCAL RESOURCE AND REGULATORY AGENCIES AND PRIVATE AND PUBLIC GROUPS CONTACTED REGARDING THE G-EAST AND SITE 92 EA

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COORDINATION LETTERS RECEIVED FROM LOCAL, STATE & FEDERAL RESOURCE & REGULATORY AGENCIES & CITIZEN GROUPS

NOAA Chesapeake Bay Office

410 SEVERN AVE. SUITE 107A
ANNAPOLIS, MD 21403

Telephone: 410-267-5660
Fax: 410-267-5666

DATE: March 22, 1996 **# of Pages** (incl. cover): 1

TO: Tammy Banta

Organization: MES

Telephone: (410) 974 - 7261

Fax: (410) 974 - 7236

FROM: Lee Crockett

SUBJECT: Pooles Island Fisheries Monitoring

NOTES:

As we discussed on the phone the other day, here are NMFS' goals and objectives for fisheries monitoring at the G-East site. Tim Goodger and John Nichols have reviewed this statement and agree with its content.

"The NMFS believes that portions of the proposed G-East dredged material placement sites have high value for fish and therefore, should not be covered with dredged material. In particular, we believe that the high relief portion on the east side of the proposed site is important to fisheries. Therefore, our goals and objectives for monitoring are to quantify the relative worth of the high relief area to fish in comparison to other portions of the proposed site. We would like to see: 1) a bathymetric survey of the site to delineate the high relief area; 2) a hydrology survey to identify the currents at the site; 3) a fisheries survey to quantify fish use of the high relief and flat portions of the site; and 4) a survey of the benthic community to assess the relative importance of each area as a food source for fish. This information will allow us to determine where material can be placed at the site with the least impact to fisheries."

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401

July 22, 1996

Ms. Tammy Rose Banta
Maryland Environmental Service
2011 Commerce Park Drive
Annapolis, MD 21401

Re: Pooles Island Dredged Material Placement Sites for C&D Canal Deepening Projects

Dear Ms. Banta:

This responds to your July 10, 1996, request for information on the presence of species which are Federally listed or proposed for listing as endangered or threatened in the project area. We have reviewed the information you enclosed and are providing comments in accordance with Section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*).

The shortnose sturgeon *(Acipenser brevirostrum)*, an endangered species under the regulatory jurisdiction of the National Marine Fisheries Service, occurs in the upper Chesapeake Bay area. The migration route to this area may well be the C&D Canal. For further information on this species, please contact Laurie Silva of NMFS at (508) 281-9291.

Except for occasional transient individuals, no other Federally listed or proposed endangered or threatened species are known to exist in the project impact area. Therefore, no Biological Assessment or further Section 7 Consultation with the U.S. Fish and Wildlife Service is required. Should project plans change, or if additional information on the distribution of listed or proposed species becomes available, this determination may be reconsidered. For information on other rare species, you should contact Ms. Lynn Davidson of the Maryland Natural Heritage Program at (410) 974-2870.

Thank you for your interest in fish and wildlife issues. If you have any questions or need further assistance, please contact Andy Moser at (410) 573-4537.

Sincerely,

for John P. Wolflin
Supervisor
Chesapeake Bay Field Office

Parris N. Glendening
Governor

Maryland Department of Natural Resources
Forest, Wildlife and Heritage Service
Tawes State Office Building
Annapolis, Maryland 21401

John R. Griffin
Secretary

Ronald N. Young
Deputy Secretary

July 23, 1996

Maryland Environmental Service
attn: Ms. Tammy Rose Banta
2011 Commerce Park Dr.
Annapolis MD 21401

re: Pooles Island Dredge Material Placement Sites for C&D Canal Deepening Projects.

Dear Ms. Banta:

The Wildlife and Heritage Division has no records for Federal or State rare, threatened or endangered plants or animals within this project site. This statement should not be interpreted as meaning that no rare, threatened or endangered species are present. Such species could be present but have not been documented because an adequate survey has not been conducted or because survey results have not been reported to us.

Sincerely,

Michael E. Slattery

Michael E. Slattery GDF
Associate Director, Wildlife
and Heritage Division

ER# 96.740.harke

U.S. Department of Transportation

United States Coast Guard

Commander
Fifth Coast Guard District

431 Crawford Street
Portsmouth, VA 23704-5004
Staff Symbol: (Amr)
Phone: (757) 398-6638

16450
August 8, 1996

Mr. Wayne Young
Director
Environmental Dredging
Maryland Environmental Services
2011 Commerce Park Drive
Annapolis, MD 21401

Dear Mr. Young:

I am writing in response to your letter dated July 19, 1996, requesting information to support the environmental assessment for G-East and Site 92.

I have enclosed a copy of the environmental sensitivity chart we use for pollution contingency planning and response operations. This is the only information we have that would meet the criteria listed in your letter.

Specific species within the area are:

Great Blue Heron	Ducks
Gulls and Terns	Osprey
Double Crested Cormorant	
Hard Clam	Atlantic Menhaden
Bluefish	Spot
Eel	

The Coast Guard does not have a reference library to address the issues outlined in your letter. Our database was compiled in the mid 1980s by the Virginia Institute of Marine Science, and I would recommend that you contact them directly for additional information they may have available.

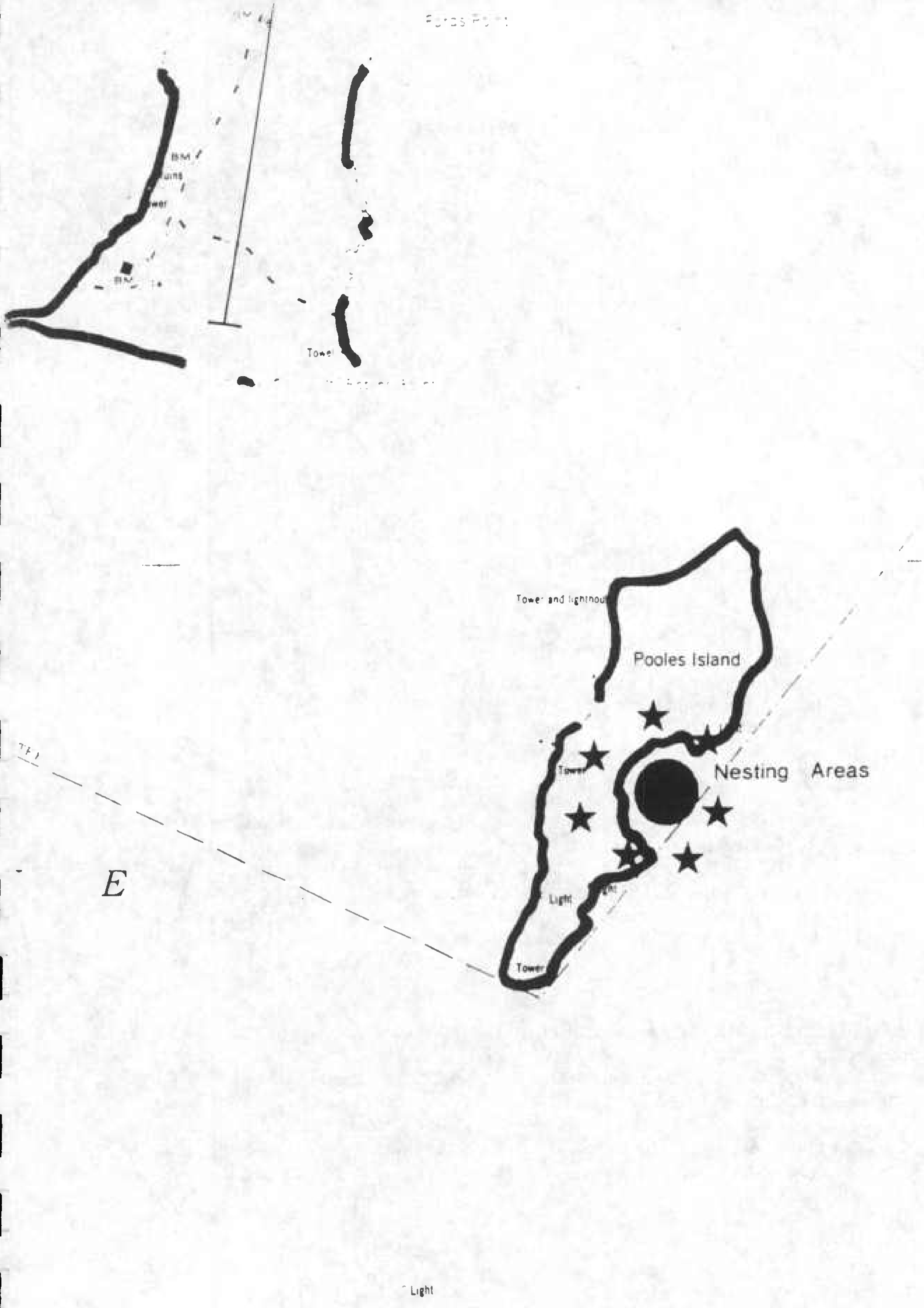
If I can be of further assistance, please call me at (757) 398-6638.

Sincerely,

J. M. Obernesser

J. M. OBERNESSER
Lieutenant Commander, U.S. Coast Guard
Chief, Area Marine Response Branch
By direction of the Commander
Fifth Coast Guard District

Encl: (1) Environmental Sensitivity Map MD-50



COMMON LOCAL SPECIES

ENCLOSURE (1)

MARYLAND HISTORICAL TRUST

Archaeology Office

August 8, 1996.

Ms. Tammy Banta
Project Manager
Maryland Environmental Service
2011 Commerce Park Drive
Annapolis, Maryland 21401

Re: Environmental Assessment for dredged material in G-East and Site 92 areas of the Chesapeake Bay

Dear Ms. Banta,

This is in response to Mr. Wayne Young's letter of July 25, 1996 and a telephone conversation with Ms. Katherine Temple this morning respecting the environmental assessment of the Pooles Island region of the Bay being undertaken by your firm. Previously, Phase I investigations were required of the G-West region of the Bay and these did result in the location of submerged cultural resources. These areas have been ranked as having moderate to high potential for sites potentially eligible for inclusion on the National Register of Historic Places. Therefore, Phase I investigations will be required of the G-East and Site 92 areas of the Chesapeake Bay.

The library here at the Maryland Historical Trust contains a number of reports and other materials which will prove helpful to the Maryland Environmental Service in preparing a scope of work. I recommend you contact Ms. Mary Louise de Sarran (410-514-7655), the librarian, to arrange access to the Trust facilities. This office will be pleased to advise on the development of a scope of work for this project. With respect to the G-West Phase I, I suggest you contact Mr. Bruce Thompson, Assistant State Underwater Archaeologist, at (410) 514-7663 since he is more knowledgeable about this specific project than I am.

Division of Historical and Cultural Programs
100 Community Place • Crownsville, Maryland 21032 • (410) 514-7601

Please let me know if I may provide further information. I may be contacted at (410) 514-7662 or 7661; fax (410) 987-4071, or e-mail: mdshpo@ari.net.

Sincerely,

Susan B.M. Langley, Ph.D.
State Underwater Archaeologist

9602766
/sl

cc. Ms. Beth Cole
Mr. Bruce Thompson

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
WANAMAKER BUILDING, 100 PENN SQUARE EAST
PHILADELPHIA, PENNSYLVANIA 19107-3390

AUG 14 1996

REPLY TO
ATTENTION OF

Environmental Resources Branch

Susan B.M. Langley, Ph.D
State Underwater Archaeologist
Maryland Historical Trust
Archaeology Office
100 Community Place
Crownsville, Maryland 21032

Dear Dr. Langley:

The Maryland Environmental Service (MES), under an agreement with the U.S. Army Corps of Engineers, Philadelphia District, is preparing an environmental assessment of the Pooles Island region of the Chesapeake Bay for future dredged material disposal needs related to the maintenance of the northern approach channels of the Chesapeake and Delaware Canal. A Phase 1 cultural resources investigation at the proposed G-East and Site 92 areas is planned for this September. As part of our Section 106 coordination for this project, please find enclosed a Phase 1 scope of work for your review and comment. This scope is based on previous work conducted by the District at the G-West and C & D Canal approach channel project areas.

Please provide our office with any comments or concerns you may have within 30 days of the date of this letter. You can contact Michael Swanda, Environmental Resources Branch, at (215) 656-6556 if you have any questions or need further information concerning the project.

Sincerely,

for John A Burns

Robert L. Callegari
Chief, Planning Division

Enclosure

CF:
MES, Tammy Banta
MHT, Bruce Thompson

Parris N. Glendening
Governor

John R. Griffin
Secretary

Carolyn D. Davis
Deputy Secretary

Maryland Department of Natural Resources
Environmental Review
Tawes State Office Building
Annapolis, Maryland 21401

September 4, 1996

Mr. Wayne Young
Director, Environmental Dredging Division
Maryland Environmental Service
2011 Commerce Park Drive
Annapolis, Maryland 21401

RE: Request for Information: Pooles Island-Open Water Placement/Site 92 and G-East; Chesapeake Bay Area; Harford County

Dear Mr. Young:

In response to your request for baseline environmental information on the above referenced areas for the proposed overboard disposal of dredged material, we have coordinated a review of the project by the Department of Natural Resources. However, it is our understanding this request for information was sent directly to several Departmental units and these agencies may be responding directly to Maryland Environmental Service. Therefore, you may receive additional comments from others in the Department. The following comments were received by the Environmental Review Unit in response to your request:

Site 92

Site 92, as depicted on the map accompanying your request, does not appear to present any conflicts with existing, known shellfish resources or with the Department's shell dredging programs in the upper Bay.

G-East

G-East, as depicted on the map accompanying your request, does not appear to present any conflicts with existing, known shellfish resources. However, the proposed disposal site does impact the Department's shell dredging program. The Department has a location designated

Telephone: (410) 974-2788
DNR TTY for the Deaf: (410) 974-3683

"Area D" which has been permitted by the U.S. Army Corps of Engineers and the Maryland Department of the Environment for the Department's shell dredging program. Approximately 40% of Area D is included in the proposed boundaries of G-East.

The Department is currently utilizing Area D for its shell dredging program, however much of the area of overlap with the proposed G-East site has been dredged. The dredged locations have remaining shell deposits, but due to current economics other locations within Area D are being dredged. However, the need for shell is anticipated to be greater in the next few years due to the increased demands for shell in conjunction with a variety of oyster restoration initiatives. Therefore, there may be a need to return to these previously dredged sites in Area D to fulfill the demands for more shell due to the new restoration projects. Thus the Department would not wish to have the current area available for shell dredging reduced. The Maryland Environmental Service should adjust the boundaries of the G-East site, to avoid if possible, the overlap with Area D.

Thank you for the opportunity to provide comments on this project. Should you require additional information regarding these comments, please feel free to contact Dr. Roland Limpert of my staff at (410) 974-2788.

Sincerely,

Ray C. Dintaman, Jr.

Ray C. Dintaman, Jr., Director
Environmental Review Unit

RCD:RJL
cc: D. Leonard, DNR-FS
S. Jordan, DNR-FS
C. Judy, DNR-FS

MARYLAND HISTORICAL TRUST

-is N. Glendening
Governor

Patricia J. Payne
Secretary, DHCD

Archaeology Office

September 6, 1996

Robert L. Callegari
Chief, Planning Division
Department of the Army
Philadelphia District, Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3390

Dear Mr. Callegari,

This is in response to your letter of August 14, 1996, pertaining to the scope of work prepared by the Maryland Environmental Service for Phase I cultural resources investigation at the proposed G-East and Site 92 areas of Chesapeake Bay. Comments contained herein are the result of concerns expressed to me by Mr. Bruce Thompson, who is most familiar with previous work in the area; differences from previous practise are likely the result of my presence in this position over the past two years. I am implementing changes in order to develop standards and guidelines for underwater archaeology within the state. These are not yet drafted as I wish to incorporate reasonable requirements which are demonstrably effective.

(Pg. 1) The most obvious difference from previous practice is that surveys done entirely by remote sensing are no longer acceptable. In a terrestrial context we would not accept a survey done completely with ground penetrating radar and not including and shovel tests. Ground truthing remote sensing targets is necessary.

The scope of work cites Standards and Guidelines in a "Technical Report Number 2." This document is more appropriately cited as *Standards and Guidelines for Archeological Investigations in Maryland* (Shaffer and Cole, 1994). However, an awareness of the Secretary of the Interior's Standards and Guidelines is also requisite.

(Pg. 3 A.) The dates of the reports do not appear to be correct. There are 4 volumes on this project and the date is February 1995. There are also reports by T.A.R. and OSI. For more information about these please contact Mr. Bruce Thompson at (410) 514-7663.

(Pg. 4) The standard line spacing we are now recommending is 50 feet for all remote sensing work, including magnetometer and side scan sonar. Mr. Thompson has also suggested a side scan frequency of 500Khz and a 25m scale.

(Pg. 6 C2.) As mentioned previously, evaluation will involve diving. I am unclear as to who the District archaeologist is in section IV A & B, and the CoE archaeologist in IV C. I would also appreciate being contacted both prior to (1 week's notice) and during the period work is performed so as to assist with any difficulties should these arise.

(Pg. 7 V A.) What are the correct dates? Obviously, July 31, 1995 and August 31, 1995 are incorrect. The correct term is Maryland Historical Trust, not "Historic Trust."

(Pg. 8 V A.) Correct the reference to the Standards and Guidelines. See page 1.

(Pg. 9 D.) Submerged cultural remains include more than shipwrecks and the scope should address these. This section should, of course, also address the results of the diving examination of the targets.

If you have any questions or wish to discuss these comments further, please contact either me (410) 514-7662 or Mr. Bruce Thompson (410) 514-7663. I would recommend Mr. Thompson be your point of reference as he has previous experience with this specific area. Our fax number is (410) 987-4071 and our e-mail address is mdshpo@ari.net.

Sincerely,

Susan B.M. Langley, Ph.D.
State Underwater Archaeologist

cc. Bruce Thompson, MHT
Elizabeth Cole, MHT
Michael Swanda, COE
Tammy Banta, MES

MARYLAND
ENVIRONMENTAL
SERVICE

Parris N. Glendening
Governor

James W. Peck
Director

September 25, 1996

Ms. Laurie Silva
National Marine Fisheries Service
1 Blackburn Drive
Glochester, MA 01930

Dear Ms. Silva

This letter is written to iterate the conversation you had with Ms. Suzanne Hebert of my staff pertaining to the presence of threatened or endangered species in the Pooles Island vicinity of the Chesapeake Bay and also to request any information you may have available on the short-nosed sturgeon (*Acipenser brevirostrum*)

As the Chesapeake Bay Field Office of the Fish and Wildlife Service wrote, and you confirmed no Federally listed or proposed for listing threatened or endangered species are known to exist in the proposed dredged material placement project areas in the vicinity of Pooles Island, Chesapeake Bay and the short-nosed sturgeon may use the C&D Canal as a migration route. Therefore, no Biological Assessment or further Section 7 Consultation would be required.

As part of our Environmental Assessment for proposed placement of dredged material in the Pooles Island vicinity, we will be discussing the short-nosed sturgeon and would appreciate any information you have available on this species. This information should be sent to the attention of Ms. Suzanne Hebert. Should you have any questions or comments, Suzanne or I can be reached at (410) 974-7261 Thank you for your time.

Sincerely,

Tammy Rose Banta

Tammy Rose Banta
Project Manager
Environmental Dredging

cc: Mr. David Bibo, Maryland Port Administration
Mr. Walter DePrefontaine, Philadelphia District, USACE
Ms. Barbara Conlin, Philadelphia District, USACE

Ms. Tammy Rose Banta
Project Manager
Environmental Dredging
Maryland Environmental Service
2011 Commercial Park Drive
Annapolis, MD 21401

Attn: Suzanne Hebert

Dear Ms. Banta:

This is in response to your recent letter regarding the presence of threatened or endangered species in the Pooles Island vicinity of the Chesapeake Bay.

To further clarify the statement in your letter about the C&D Canal, shortnose sturgeon have occasionally been found in the Chesapeake Bay and it is speculated that they probably came thru the C&D Canal from the Delaware River population.

Enclosed is a Synopsis of Biological Data on Shortnose Sturgeon that you may find helpful. If you have any further questions, please feel free to contact me at (508) 281-9291.

Sincerely,

Laurie A. Silva
Protected Species

Enclosure

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401

November 26, 1996

Ms. Tammy Rose Banta
Maryland Environmental Service
2011 Commerce Park Drive
Annapolis, MD 21401

Re: Pooles Island Dredged Material Placement Sites for C&D Canal Deepening Projects - Site 92 Expansion

Dear Ms. Banta:

This responds to your November 25, 1996, request for information on the presence of species which are Federally listed or proposed for listing as endangered or threatened in the project area. We have reviewed the additional information you enclosed and are providing comments in accordance with Section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*).

As we stated in the July 22, 1996 and September 25, letters that we sent to your office, the shortnose sturgeon *(Acipenser brevirostrum)*, an endangered species under the regulatory jurisdiction of the National Marine Fisheries Service, has been caught in the upper Chesapeake Bay area. The route to this area may well be the C&D Canal. For further information on this species, please contact John Nichols of NMFS at (410) 226-5771.

Except for occasional transient individuals, no other Federally listed or proposed endangered or threatened species are known to exist in the project impact area. Therefore, no Biological Assessment or further Section 7 Consultation with the U.S. Fish and Wildlife Service is required. Should project plans change, or if additional information on the distribution of listed or proposed species becomes available, this determination may be reconsidered. For information on other rare species, you should contact Ms. Lynn Davidson of the Maryland Natural Heritage Program at (410) 974-2870.

Thank you for your interest in fish and wildlife issues. If you have any questions or need further assistance, please contact Andy Moser at (410) 573-4537.

Sincerely,

for John P. Wolflin
Supervisor
Chesapeake Bay Field Office

cc: John Gill (CBFO)
George Ruddy (CBFO)
Jorgen Skjeveland (USFWS)
Steve Wampler (Aberdeen Proving Grounds)
Laurie Silva (NMFS)
Tim Goodger (NMFS)
Nick Carter (MD DNR)

Parris N. Glendening
Governor

Maryland Department of Natural Resources
Forest, Wildlife and Heritage Service
Tawes State Office Building
Annapolis, Maryland 21401

John R. Griffin
Secretary

Carolyn D. Davis
Deputy Secretary

December 9, 1996

Maryland Environmental Service
Attn: Ms. Tammy Rose-Banta
2011 Commerce Park Drive
Annapolis, MD 21401

RE: **Poole's Island Dredged Material Placement Sites for C & D Canal Deepening Projects- Site 92 Reconfiguration**

Dear Ms. Rose-Banta:

The Wildlife and Heritage Division has no records for Federal or State rare, threatened or endangered plants or animals within this project site. This statement should not be interpreted as meaning that no rare, threatened or endangered species are present. Such species could be present but have not been documented because an adequate survey has not been conducted or because survey results have not been reported to us.

Nearby Poole's Island is the site of a very large Great Blue Heron colony. Provided that the dredging and related activities are limited to the delineated area you had indicated on the map previously sent, the project should not impact the heron colony. If you should have any further questions, please contact Ms. Lori Byrne at the above address or phone number.

Sincerely,

Michael E. Slattery
Associate Director, Wildlife
& Heritage Division

ER# 96.1875.ha

Telephone: (410) 974-3195
DNR TTY for the Deaf: 301-974-3683

Environmental Resources Branch

Susan B.M. Langley, Ph.D
State Underwater Archaeologist
Maryland Historical Trust
Archaeology Office
100 Community Place
Crownsville, Maryland 21032

Dear Dr. Langley:

The Maryland Environmental Service (MES), under an agreement with the U.S. Army Corps of Engineers, Philadelphia District, is preparing an environmental assessment of the Pooles Island region of the Chesapeake Bay for future dredged material disposal needs related to the maintenance of the northern approach channels of the Chesapeake and Delaware Canal. A Phase 1 cultural resources investigation at the proposed G-East and Site 92 areas was completed this past October. The draft report of this investigation entitled "A Phase I Submerged Cultural Resources Investigation, Upper Chesapeake Bay, Maryland (G-East Disposal Site and Disposal Site #92)" (Dolan Research, Inc. and Hunter Research, Inc. 1996) is enclosed for your review. The underwater survey identified two potentially significant remote sensing targets. Avoidance of the remote sensing targets during proposed dredged material disposal activities is recommended.

Your review and comments of this report would be most helpful if received within 30 days. Please do not hesitate to contact Michael Swanda, Environmental Resources Branch at (215) 656-6556 if you have any questions or need further information.

Sincerely,

Robert L. Callegari
Chief, Planning Division

Enclosure

CF:

CURRENT AND HISTORICAL RARE, THREATENED, AND ENDANGERED SPECIES OF HARFORD COUNTY, MARYLAND*

January 3, 1997

Maryland Department of Natural Resources
Wildlife and Heritage Division

Scientific Name	Common Name	Global Rank	State Rank	State Status	Federal Status
Animals					
Acipenser brevirostrum	Shortnose sturgeon	G3	S1	E	LE
Acipenser oxyrinchus	Atlantic sturgeon	G3	S1		
Clemmys muhlenbergii	Bog turtle	G3	S2	T	C
Erynnis martialis	Mottled dusky wing	G4	S1	E	
Etheostoma sellare	Maryland darter	G1	S1	E	LE
Etheostoma vitreum	Glassy darter	G4G5	S1	E	
Graptemys geographica	Map turtle	G5	S1	E*	
Haliaeetus leucocephalus	Bald eagle	G4	S2S3	E	LT
Percina caprodes	Logperch	G5	S1		
Sperchopsis tessellatus	A hydrophilid beetle	G?	S?		
Speyeria idalia	Regal fritillary	G3	S1	E	
Stygobromus tenuis tenuis	Tenuis amphipod	G4T2Q	SU		
Plants					
Amelanchier spicata	Running juneberry	G5	S1	T	
Anemone canadensis	Canada anemone	G5	SH	X	
Antennaria solitaria	Single-headed pussytoes	G5	S1	T	
Asplenium bradleyi	Bradley's spleenwort	G4	SH	X	
Asplenium pinnatifidum	Lobed spleenwort	G4	S1	E	
Aster depauperatus	Serpentine aster	G2Q	S1	E	
Aster radula	Rough-leaved aster	G5	S1	E	
Bidens bidentoides var mariana	Maryland bur-marigold	G3T3	S3.1		
Bidens coronata	Tickseed sunflower	G5	S2S3		
Bidens discoidea	Swamp beggar-ticks	G5	S2S3		
Bidens mitis	Small-fruited beggar-ticks	G4?	S1	E	
Boltonia asteroides	Aster-like boltonia	G5	S1	E	
Buchnera americana	Blue-hearts	G5?	SH	X	
Campanula rotundifolia	Harebell	G5	S2		
Carex buxbaumii	Buxbaum's sedge	G5	S2	T	
Carex hitchcockiana	Hitchcock's sedge	G5	S1	E	
Carex lanuginosa	Woolly sedge	G5	S2	T	
Carex louisianica	Louisiana sedge	G5	S1	E	
Carex striatula	Lined sedge	G4G5	SH	X	
Ceratophyllum muricatum	Prickly hornwort	G4G5	S1	E	
Coreopsis tripteris	Tall tickseed	G5	S1	E	
Cuscuta polygonorum	Smartweed dodder	G5	S1	E	
Cyperus dentatus	Toothed sedge	G4	SH	X	
Cyperus retrofractus	Rough cyperus	G5	S2		
Cystopteris tennesseensis	Tennessee bladder-fern	G5	S1		
Desmodium rigidum	Rigid tick-trefoil	G?Q	S1	E	
Desmodium viridiflorum	Velvety tick-treefoil	G5?	S1S2		
Diplazium pycnocarpon	Glade fern	G5	S1	T	
Elatine americana	American waterwort	G4	S1S2	E	
Elatine minima	Small waterwort	G5	S1	E	
Equisetum fluviatile	Water horsetail	G5	S1	E	
Eriocaulon aquaticum	Seven-angled pipewort	G5	SH	X	
Eriocaulon parkeri	Parker's pipewort	G3	S2	T	
Euphorbia purpurea	Darlington's spurge	G3	S1	E	
Gentiana andrewsii	Fringe-tip closed gentian	G4	S2	T	
Geum aleppicum	Yellow avens	G5	S1	E	
Hydrastis canadensis	Goldenseal	G4	S1	T	
Juncus balticus	Baltic rush	G5	SH	X	
Juncus brachycarpus	Short-fruited rush	G4G5	SH	X	
Juncus longii	Long's rush	G3G4Q	SH	X	
Limosella australis	Mudwort	G4G5	S2	E	
Linum floridanum	Florida yellow flax	G4	SH	X	
Linum sulcatum	Grooved flax	G5	S1	E	

Scientific Name	Common Name	Global Rank	State Rank	State Status	Federal Status
Ludwigia decurrens	Primrose willow	G5	S2		
Lygodium palmatum	Climbing fern	G4	S2	T	
Lysimachia hybrida	Lowland loosestrife	G5	S1	E	
Matteuccia struthiopteris	Ostrich fern	G5	S2		
Panicum flexile	Wiry witch-grass	G4G5	S1	E	
Pedicularis lanceolata	Swamp lousewort	G5	S1	E	
Polanisia dodecandra	Clammyweed	G5Q	SH	X	
Polemonium vanbruntiae	Jacob's-ladder	G3	S2	T	
Polygala senega	Seneca snakeroot	G4G5	S2	T	
Polygonum robustius	Stout smartweed	G4G5	SH	X	
Potamogeton amplifolius	Large-leaved pondweed	G5	SH	X	
Potamogeton foliosus	Leafy pondweed	G5	S1	E	
Potamogeton perfoliatus	Clasping-leaved pondweed	G5	S2		
Potamogeton pusillus	Slender pondweed	G5	S1		
Potamogeton richardsonii	Redheadgrass	G5	SH	X	
Potamogeton spirillus	Spiral pondweed	G5	S1		
Potamogeton zosteriformis	Flatstem pondweed	G5	SH	X	
Pycnanthemum verticillatum	Whorled mountain-mint	G5	S1	E	
Quercus macrocarpa	Mossy-cup oak	G5	S1		
Ranunculus ambigens	Water-plantain spearwort	G4	SH	X	
Rhynchospora globularis	Grass-like beakrush	G5	S1	E	
Sagittaria calycina	Spongy lophotocarpus	G5	S2		
Sagittaria longirostra	Long-beaked arrowhead	G?	SU		
Salix tristis	Dwarf prairie willow	G5T?	S1		
Sanguisorba canadensis	Canada burnet	G5	S2	T	
Scirpus cylindricus	Salt-marsh bulrush	G5	S2		
Scutellaria leonardii	Leonard's skullcap	G4T4	S2	T	
Silene nivea	Snowy campion	G4?	S1	E	
Smilacina stellata	Star-flowered false Solomon's-seal	G5	S1	E	
Stachys clingmanii	Clingman's hedge-nettle	G3	S1	E	
Stellaria alsine	Trailing stitchwort	G5	S1	E	
Stenanthium gramineum	Featherbells	G4G5	S1	T	
Synosma suaveolens	Sweet-scented indian-plantain	G3	S1	E	
Talinum teretifolium	Fameflower	G4	S1	T	
Thaspium trifoliatum	Purple meadow-parsnip	G5	S1	E	
Triadenum tubulosum	Large marsh St. John's-wort	G4?	S1		
Trillium flexipes	Drooping trillium	G5	S1	E	
Valeriana pauciflora	Valerian	G4	S1	E	
Viola incognita	Large-leaved white violet	G5	S1		

* This report represents a compilation of information in the Wildlife and Heritage Division's Biological and Conservation Data system as of the date on this report. It does not include species considered to be "watch list" or more common species Please refer to the attachment for an explanation of the rank and status codes.

EXPLANATION OF RANK AND STATUS CODES

Originally developed and instituted by The Nature Conservancy, an international conservation organization, the global and state ranking system is used by all 50 state Natural Heritage Programs and numerous Conservation Data Centers in other countries in this hemisphere. Because they are assigned based upon standard criteria, the ranks can be used to assess the range-wide status of a species as well as the status within portions of the species' range. The primary criterion used to define these ranks are the number of known distinct occurrences with consideration given to the total number of individuals at each locality. Additional factors considered include the current level of protection, the types and degree of threats, ecological vulnerability, and population trends. Global and state ranks are used in combination to set inventory, protection, and management priorities for species both at the state as well as regional level.

GLOBAL RANK

G1 Highly globally rare Critically imperiled globally because of extreme rarity (typically 5 or fewer estimated occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 Globally rare. Imperiled globally because of rarity (typically 6 to 20 estimated occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 Either very rare and local throughout its range or distributed locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout its range; typically with 21 to 100 estimated occurrences.

G4 Apparently secure globally, although it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally, although it may be quite rare in parts of its range, especially at the periphery.

GH No known extant occurrences (i.e., formerly part of the established biota, with the expectation that it may be rediscovered).

GU Possibly in peril range-wide, but its status is uncertain; more information is needed.

GX Believed to be extinct throughout its range (e.g., passenger pigeon) with virtually no likelihood that it will be rediscovered.

G? The species has not yet been ranked.

_Q Species containing a "Q" in the rank indicates that the taxon is of questionable or uncertain taxonomic standing (i.e., some taxonomists regard it as a full species, while others treat it at an infraspecific level).

_T Ranks containing a "T" indicate that the infraspecific taxon is being ranked differently than the full species.

STATE RANK

- **S1** Highly State rare. Critically imperiled in Maryland because of extreme rarity (typically 5 or fewer estimated occurrences or very few remaining individuals or acres in the State) or because of some factor(s) making it especially vulnerable to extirpation. Species with this rank are actively tracked by the Natural Heritage Program.

- **S2** State rare. Imperiled in Maryland because of rarity (typically 6 to 20 estimated occurrences or few remaining individuals or acres in the State) or because of some factor(s) making it vulnerable to becoming extirpated. Species with this rank are actively tracked by the Natural Heritage Program.

- **S3** Watch List. Rare to uncommon with the number of occurrences typically in the range of 21 to 100 in Maryland. It may have fewer occurrences but with a large number of individuals in some populations, and it may be susceptible to large-scale disturbances. Species with this rank are not actively tracked by the Natural Heritage Program.

- **S3.1** A "Watch List" species that is actively tracked by the Natural Heritage Program because of the global significance of Maryland occurrences. For instance, a G3 S3 species is globally rare to uncommon, and although it may not be currently threatened with extirpation in Maryland, its occurrences in Maryland may be critical to the long term security of the species. Therefore, its status in the State is being monitored.

- **S4** Apparently secure in Maryland with typically more than 100 occurrences in the State or may have fewer occurrences if they contain large numbers of individuals. It is apparently secure under present conditions, although it may be restricted to only a portion of the State.

- **S5** Demonstrably secure in Maryland under present conditions.

- **SA** Accidental or a vagrant in Maryland.

- **SE** Established, but not native to Maryland; it may be native elsewhere in North America.

- **SH** Historically known from Maryland, but not verified for an extended period (usually 20 or more years), with the expectation that it may be rediscovered.

- **SP** Potentially occurring in Maryland or likely to have occurred in Maryland (but without persuasive documentation).

- **SR** Reported from Maryland, but without persuasive documentation that would provide a basis for either accepting or rejecting the report (e.g., no voucher specimen exists).

- **SRF** Reported falsely (in error) from Maryland, and the error may persist in the literature.

- **SU** Possibly rare in Maryland, but of uncertain status for reasons including lack of historical records, low search effort, cryptic nature of the species, or concerns that the species may not be native to the State. Uncertainty spans a range of 4 or 5 ranks as defined above.

- **SX** Believed to be extirpated in Maryland with virtually no chance of rediscovery.

- **S?** The species has not yet been ranked.

- **_B** This species is a migrant and the rank refers only to the breeding status of the species. Such a migrant may have a different rarity rank for non-breeding populations.

FEDERAL STATUS

This is the status of a species as determined by the U.S. Fish and Wildlife Service's Office of Endangered Species, in accordance with the Endangered Species Act. Definitions for the following categories have been modified from 50 CRF 17.

LE Taxa listed as endangered, in danger of extinction throughout all or a significant portion of their range.

LT Taxa listed as threatened, likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

PE Taxa proposed to be listed as endangered.

PT Taxa proposed to be listed as threatened.

C Candidate taxa for listing for which the Service has on file enough substantial information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened.

STATE STATUS

This is the status of a species as determined by the Maryland Department of Natural Resources, in accordance with the Nongame and Endangered Species Conservation Act. Definitions for the following categories have been taken from Code of Maryland Regulations (COMAR) 08.03.08.

E Endangered; a species whose continued existence as a viable component of the State's flora or fauna is determined to be in jeopardy.

I In Need of Conservation; an animal species whose population is limited or declining in the State such that it may become threatened in the foreseeable future if current trends or conditions persist.

T Threatened; a species of flora or fauna which appears likely, within the foreseeable future, to become endangered in the State.

X Endangered Extirpated; a species that was once a viable component of the flora or fauna of the State, but for which no naturally occurring populations are known to exist in the State.

* A qualifier denoting the species is listed in a limited geographic area only.

MARYLAND HISTORICAL TRUST

Archaeology Office

January 17, 1997

Robert L. Callegari
Chief, Planning Division
Environmental Resources Branch
Department of the Army
Philadelphia District, Corps of Engineers
Wannamaker Building, 100 Penn Square East
Philadelphia, Pennsylvania 19107-3391

Dear Mr. Callegari,

This letter is in response to the draft report, *A Phase I Submerged Cultural Resources Investigation Upper Chesapeake Bay, Maryland (G-East Disposal Site and Disposal Site #92)*, received in this office December 31, 1996. It appears that few, if any, of the requirements and requests outlined in my letter of September 6, 1996 (duplicate enclosed) were met. Diving and manual testing of targets were not undertaken, line spacing was correct only in one area, and I received no advance notification of the field work; even corrected spellings such as Maryland Historical Trust, were not incorporated

There are several references to the need for "future" studies to determine the existence of prehistoric remains, but no justification as to why this should occur in the future versus the present was given and no efforts were made to locate these. Citing previous research and noting that such studies are neither easy nor inexpensive does not preclude the need for the work to be done.

Since this report is prepared for a government agency well acquainted with the relevant heritage legislation and National Register criteria and requirements, as opposed to a private sector client, much of Chapter 1 is extraneous. The prehistory of the area could be more concise; Archaic lifeways on the coast of Maine are not particularly pertinent. Similarly, the minutiae of the establishment of ports, specifics of cargoes, and regulations governing lading are not as important as generalities such as, the types of vessels and other cultural resources likely to be in the project area; this section could also be condensed.

Although finding that the project has high potential for submerged prehistoric sites, and citing projects where such sites have been documented, no efforts were made to test for such sites using the excuse that, here "such data are not readily available, and both expensive and logistically awkward to derive and interpret" (P. 4-2). Again, difficulty does not preclude necessity, and the "awkwardness" will not diminish without further efforts in this area. Excavations of prehistoric sites to substantial depths have been successfully undertaken; one example is the work carried out by Easton, Moore and Mason (1993 CUA Proceedings) in Montauk Harbour, British Columbia. However, these sites (even those including prehistoric watercraft) are less likely to be located in bottom sediments using magnetic and side scan remote sensing apparati, than when subsediment imaging and direct diver inspection are involved (i.e., coring, probing, test units).

The recommendations in the draft are for a continuation of Phase I testing using "more focused" remote sensing and diver testing on the targets which the consultants indicate have potential significance. Should the targets prove to be archaeological in nature, Phase II studies would be required to determine their eligibility for the National Register and avoidance of the area for dredge material disposal is recommended. This has become abbreviated in the cover letter to "Avoidance of the remote sensing targets during proposed dredge material disposal activities is recommended." Had the recommendations of the Trust's September 6 letter been followed, a definitive statement of the targets' significance would be in hand and their eligibility for the NR known. This office concurs with the recommendation in the draft report that further study of the targets is necessary to identify them and to determine their significance. Limited core sampling to test for evidence of prehstoric cultural remains could be undertaken at this time. Avoidance of submerged resources during the disposal of dredged materials is beyond the capabilities of this office to monitor and enforce.

Since any artifacts recovered are from State-owned bottomlands, they are to be deposited, after conservation, with the Maryland Historical Trust and are not to be held by the consultant.

Additional editorial corrections required follow:

The possessive form of proper nouns ending in "s" requires an "'s." For example, dogs is correct, but it is Harris's, not Harris' as in the Acknowledgements.

In a sequence of clauses separated by semi-colons, the punctuation prior to the final clause is a comma and not a semi-colon.

P. 1-1, Col. 1	
Line 8	Change "Inc." to "Inc.,"
Line 27	Change "data;" to "data,"
Line 28	Change "twofold" to "two-fold"
Line 33	Change "activities;" to "activities,"
Col. 2	
Line 7	Change "section" to "sections"
Line 15	Change "1986);" to "1986),"
P. 1-4, Col. 1	
Line 17	Change "a" to "an"
P. 1-6, Col. 1	
Line 4	Change "mid 1900s" to "mid-1900s"
Col. 2	
Line 17	Change "Historic" to "Historical"
Line 21	Change "Museum;" to "Museum,"
Line 28	Change "focussed" to "focused" (ether is correct, but the latter is used consistently elsewhere)

P. [illegible], Col. 1	
Line 14	Change "detail" to "details"
P. 2-1, Col. 2	
Line 15	Change "ovular" to "ovate" or "oval"
P. 3-1, Col. 1	
Lines 28-29	Either, "Sea levels have risen, and continue to rise," or "Sea level has risen, and continues to rise."
Col. 2	
Lines 28 and 30	Add Linnaean classifications to all flora and fauna, eg. "pine (*Pinus sp.*) and oak (*Quercus sp.*)"
P. 3-2, Col. 1	
Line 5	Change "reflect" to "reflects"
Line 16	Delete either "Thus" (Line 14) or "therefore"
Para. 3	Add Linnaean terminology throughout
P. 3-3, Col. 2	
Line 3	Change "beenpreviously" to "been previously"
Line 18	Change "Godwin" to "Goodwin"
P. 3-5, Col. 1	
Lines 5 and 6	Italicize or underscore vessel names (italics are preferred)
Col. 2	
last line	Italicize "Ark"
P. 3-6, Col. 1	
Line 1	Italicize "Dove"
Line 4	Change "Colony" to "colony"
Line 9	Change "parliament" to "Parliament"
Line 25	Change "County seat" to "County"
Line 36	Change "town acts" to "Town Acts"
Line 39	Change "ports" to "Ports"
P. 3-7, Col. 2	
Line 29	Change "Annapolis or Oxford" to "Annapolis, nor Oxford"
P. 3-8, Col. 1	
Lines 8 and 9	Italicize vessel names
Col. 2	
Lines 14-16	Italicize vessel names
Line 18	Change "port" to "Port"
Line 35	Change "Annapolis'" to "Annapolis's"
Line 37	Change "her" to "its" (even the Navy no longer applies gender specific terms to inanimate things)
Line 42	Change "Annapolis'" to "Annapolis's"
P. 3-9, Col. 1	
Line 20	Italicize "Maryland"
Line 22	Change "her" to "its"

Col. 2 last sentence	Add Linnaean terminology
P. 4-1, Col. 2 Line 21	Change "deposited." to "deposited."
P. 5-4, Col. 1 Line 1	Change "5 l and" to "5 l and"
Col. 2 Line 14	Change "POLB" to "Pool B" - I am uncertain about this [illegible]
Line 18	Change "s17" to "17"

Why are none of the titles of reports underscored, this seems inconsistent?

P. R-6 Lines 2 and 3	Move "Shomette, D." to begin next reference
P. A-1 Lines 2 and 3	Change "Underwater Archaeology Branch" to "Maryland Maritime Archaeology Program"
Line 3	Change "Historic" to "Historical"
Line 10	Change "Historic" to "Historical"
P. A-2 Line 8	Is "T Tern" correct; I am unfamiliar with this name? Also, italicize

During the preparation of this response, I had the pleasure of speaking with Mr. Michael Swanda of your office and very much appreciate his advice and insights addressing many of my concerns. I hope to consult with him in the future in drafting Maryland's standards and guidelines for underwater research. If you have any questions or require further information, please contact me at 410-514-7662, fax 410-987-4071, or e-mail: mdshpo@ari.net.

Sincerely,

Susan B.M. Langley, Ph.D.
State Underwater Archaeologist

/sl
encl.

cc: Michael Swanda, COE
Bruce Thompson, MHT

TOTAL P.09

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

FEB 3 1997

Lieutenant Col. Robert B. Keyser
District Engineer
Philadelphia District, Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, PA 29207-3390

Attn: Chip DePrefontaine, Operations Division, Technical Support Branch

Dear Colonel Keyser:

Recently we received a request from the Maryland Environmental Service (MES) for information regarding the presence of endangered species under our agency's purview within areas proposed for placement of dredge material from the Chesapeake & Delaware (C&D) Canal approach channels in the upper Chesapeake Bay. The request specifically concerned shortnose sturgeon (Acipenser brevirostrum) use of the proposed placement sites at G-East and Site 92 near Pooles Island. The comments that follow provide details of our response to MES and an update of the status of the shortnose sturgeon in the Chesapeake Bay. This information should be helpful to your agency relative to your responsibilities under the Endangered Species Act that accompany your District's maintenance of the C&D Canal approach channels in the upper Chesapeake Bay.

Takings of shortnose sturgeon in the Chesapeake Bay and its tributaries, although recorded since the late nineteenth century, have been rare and sporadic and have been primarily concentrated in the upper bay region. However, with initiation of a "bounty" system in 1996 by the U.S. Fish & Wildlife Service (FWS) on all sturgeon taken by Chesapeake Bay commercial fisheries in pound nets and by other means, documented takes of shortnose sturgeon have recently increased in this watershed. For example, seven sturgeon taken in the upper bay, near Kent Island, and in the Potomac River were identified as A. brevirostrum by FWS during 1996. Another positively identified individual was also taken northeast of Hart-Miller Island during January 1997, approximately four miles from Pooles Island.

Little information exists on shortnose sturgeon in the Chesapeake Bay. For example, there is no data on population densities, recruitment, habitat preferences or other dynamics associated with this species. Although there is also no documentation on the origin of shortnose sturgeon taken in the Chesapeake Bay, there is a probability that these individuals have originated from the Delaware River system, and have entered the Chesapeake Bay by way of the C&D Canal. However, the increased frequency with which this species is currently being detected under the more sensitive FWS bounty system questions the hypothesis that these individuals are merely transients from a neighboring watershed.

In the absence of sufficient data, our agency cannot, at this time, accurately determine the status of the shortnose sturgeon in the Chesapeake Bay. However, it is evident that shortnose sturgeon may be present in areas associated with the approach channels and spoil disposal operations, and that further investigations need to be conducted on this species in the bay region to determine the nature of their occurrence. We strongly encourage all efforts to gather information on this species through surveys and through genetic studies to determine if individuals taken in the bay are from a local population(s) which is geographically and genetically distinct from the Delaware River population.

If you or your staff have any questions relating to shortnose sturgeon or matters pertaining to Endangered Species Act procedures, you may call Laurie Silva at (508) 281-9291, or John S. Nichols at our Oxford, Maryland field office, (410) 226-5771.

Sincerely,

Andrew A. Rosenberg, Ph.D.
Regional Administrator

TOTAL P.03

Parris N. Glendening
Governor

Maryland Department of Natural Resources
FISHERIES SERVICES
Tawes State Office Building
Annapolis, Maryland 21401

John R. Griffin
Secretary

Carolyn D. Davis
Deputy Secretary

January 22, 1997

MEMORANDUM

TO: Cece Donovan, MES

FROM: Chris Judy, Shellfish Program Chris

SUBJECT: G-East and Shell Dredging Area D

On January 14, 1997 you met with Steve Jordan, head of the Shellfish Program and the DNR Cooperative Oxford Laboratory, to discuss the issue of overlap between G-east and DNR's shell dredging area "D". This memo is the Shellfish Program' response to the issues that were raised at the meeting.

Potential conflicts of sharing the overlap area can be avoided based upon four factors:

1) Chronology: DNR has already dredged the overlap area extensively and continued use should exhaust the area by the time MES needs it. If there are shells remaining in the area when MES begins placement, potential conflicts can be avoided based on the next three factors.

2) Seasonality: If DNR is still dredging shells in the overlap area when MES begins placement, there should be no time of year conflicts due to the "seasons" for both activities. DNR's shell dredging window is from about mid May to early September at the most, but it is usually June to late August. This time will not overlap the October to March window for MES placement of material.

3) Depth: The depths at which both agencies perform their work offer a further protection against conflicts in the overlap area. DNR uses the shelly hills while MES will be using the deeper basins. Therefore, the two activities will be geographically separate.

4) Site Management: If both agencies are active in the overlap area, the shell dredging sites and the placement sites can be accurately buoyed to prevent shell dredging in placement sites or placement of soft sediments in shell dredging sites. DNR, MES and our contractors will work closely to coordinate this effort.

If you have any questions about these comments please call me at 974-3733.

cc: Steve Jordan

Telephone:________________
DNR TTY for the Deaf: (410) 974-3683

MAR 25 1997

RECEIVED

James W. Peck, Director
Maryland Environmental Services
2011 Commerce Park Drive
Annapolis, Maryland 21401

Attn: Tammy Rose-Banta

Dear Mr. Peck:

This pertains to your request for information regarding the presence of endangered species under our agency's purview within areas currently being considered for placement of dredge material from the Chesapeake & Delaware (C&D) Canal approach channels in the upper Chesapeake Bay. Your request specifically concerns shortnose sturgeon (Acipenser brevirostrum) use of the proposed placement sites at G-East and Site 92 near Pooles Island.

Takings of shortnose sturgeon in the Chesapeake Bay and its tributaries, although recorded since the late nineteenth century, have been rare and sporadic and have been primarily concentrated in the upper bay region. However, with initiation of a "bounty" system in 1996 by the U.S. Fish & Wildlife Service (FWS) on all sturgeon taken by commercial fisheries in pound nets and by other means, documented takes of shortnose sturgeon have recently increased in this watershed. For example, seven sturgeon taken in the upper bay, off Kent Island, and in the Potomac River were identified as A. brevirostrum by FWS in 1996. Another positively identified individual was also taken northeast of Hart-Miller Island in January 1997 approximately four miles from Pooles Island.

Little information exists on shortnose sturgeon in the Chesapeake Bay. For example, there is no data on population densities, recruitment, habitat preferences or other dynamics associated with this species. Although there is also no documentation on the origin of shortnose sturgeon taken in the Chesapeake Bay, there is a probability that these individuals originated from the Delaware River system and entered the Chesapeake Bay by way of the C&D Canal. However, the increased frequency with which this species is currently being detected in the bay under the more sensitive FWS bounty system strongly questions the hypothesis that these individuals are merely transients from a neighboring watershed.

In the absence of sufficient data, our agency cannot, at this time, accurately determine the status of the shortnose sturgeon in the Chesapeake Bay. However, it is evident that shortnose sturgeon may be present within the areas of G-East and Site 92 and that further investigations are needed to determine the nature of their occurrence within the Chesapeake Bay system. We are, therefore, encouraging all efforts to gather information on shortnose sturgeon in the bay through surveys and through genetic studies to determine if individuals taken in the bay are from a local population(s) which is geographically and genetically distinct from the Delaware River population.

If you or your staff have any additional questions concerning shortnose sturgeon or matters pertaining to Endangered Species Act procedures, you may call Laurie Silva at (508) 281-9291, or John S. Nichols at our Oxford, Maryland field office, (410) 226-5771.

Sincerely,

Andrew A. Rosenberg, Ph.D.
Regional Administrator

MEETING SUMMARIES

DREDGING NEEDS AND PLACEMENT OPTION PROGRAM
UPPER BAY WORKING GROUP

March 8, 1996

MEETING SUMMARY

Attendees

Jim Bailey, APG
Tammy Banta, MES
Cece Donovan, MES
Russell Green, UBCCA
Chris Judy, DNR
John Nichols, NMFS-Oxford
William Sumner, Cecil Co. Health Dept.
Michelle Vargo, MES
Steve Wampler, APG
Dave Bibo, MPA
Lee Crockett, NMFS-NCBO
John Gill, USFWS
Jeff Halka, DNR-MGS
Roland Limpert, DNR
Charles Smyser, Cecil Co. Health Dept.
Laurence Thomas, MCBA
Brian Walls, USACE-Baltimore
Nick Carter, DNR

The first meeting of the Upper Bay Working Group was called to discuss issues related to the environmental assessment of the proposed G-East open water placement area. The meeting was opened with a quick presentation of the current POP status and the need to re-establish the Pooles Island Working Group as the Upper Bay Working Group. The working group's mission was discussed with emphasis on the G-East project through the summer. The upper Bay artificial island concept would be the next project for discussion on the working groups agenda once the assessment of G-East was completed. John Gill requested that USFWS's opposition to a Hart-Miller like artificial island without beneficial use components be added to the record at this time.

Proposed Concept

A chart describing the preliminary concept and location of G-East was presented to the group. Jeff Halka reviewed the history of how the site was selected and the boundaries drawn. Data had been collected as part of the other area "G" surveys. Surveys were examined for possible placement options utilizing similar techniques as other placement sites at Pooles Island. The project concept boundaries were preliminarily drawn to enclose a shallow basin. Jeff stressed that very little effort went into defining these boundaries and that this task is part of the assessment studies. Brian Walls was concerned that the high relief areas to the south were not shown on the chart. Jeff explained that the survey that collected this data did not include the high relief areas to the south. That data was however available in other files and with some work could be incorporated into this chart. Nick Carter requested the acreage of the site. Jeff said that it had been calculated but he didn't recall the number off-hand. The estimated capacity was 4.5 mcy. G-West covers an area of 250 acres. G-East would potentially be a little be more, but that too will be defined further in the assessment studies.

Review of EA Draft Scope-of-Work and Schedule

Cece Donovan presented the draft scope-of-work and schedule to the working group. One preliminary scoping meeting between MES, MPA and PCOE had been held to get the project going. The experience of G-West and issues previously raised by citizens and resource agencies were used in developing the scope of environmental studies.

Hydrodynamic Study

Development of the scope assumed that hydrodynamic modeling would be required to answer questions about increases in velocity and erosion.

Fish Studies

Fishing activity studies were planned for April and May. Laurence Thomas suggested these studies be done from May through November for a true assessment of the fishing activity in this area.

The fish population and speciation studies were discussed. G-East was sampled as part of a reference area for the G-West site. Therefore, trawl and acoustic data already exist for G-East. Nick Carter requested that gill netting be added to the acoustic and trawl sampling in each season. Cece asked if the reason for gill netting was to represent the larger fish which can evade the trawls. Nick said yes. Cece asked if gill netting was a concern of the group. The answer was yes.

Water Quality

Water quality data already collected for G-West was available for interpretation for assessing the G-East conditions.

Sediment Flux and Migration

Nick Carter suggested that the schedule for the nutrient flux sampling needed to be revised. He was most concerned about the flux occurring during the first two years after placement. He requested that baseline sampling take place in both G-West and G-East for comparison. He also thought that sampling should occur directly after placement and then during the warm weather period. Currently, MDE only requests sampling during the summer. Since MDE was not represented, Cece said she would talk this over with them.

John Nichols asked if sediment accumulation in neighboring areas, as a result of placement, is being assessed. Jeff Halka indicated that it has been modeled for a cell in the Northern Bay. No detectable areas of deposition have been shown. Basically, the migrating material is deposited as a thin layer throughout the Bay. Cece responded that high relief areas (fish habitat) are surveyed for accumulation and have shown none to date.

Wildlife Studies

Although no wildlife studies were done for the G-West assessment and none were planned for G-East, Roland Limpert requested that studies of waterfowl be added. He explained that diving waterfowl feed on benthic organisms and diminishing the benthic populations by placement of dredged material could impact the waterfowl. Also, molting birds could be impacted during dredged material placement since they are unable to fly when molting. Roland suggests quarterly aerial counts of waterfowl, especially from October through April. Steve Wampler thought that they (APG) may have some data that would be useful for the assessment.

Cumulative Impacts of Placement

There was a long discussion on the need to address cumulative impacts. Steve Wampler questioned whether an overall EIS for all dredged material placement in the Bay exists. Some thought that maybe the C&D Deepening EIS might address this. Several people questioned when the Deepening EIS would be available, however, the date was not known by anyone present. Brian Walls agreed that EAs should address cumulative impacts according to NEPA. Wide ranging suggestions were made as to how to deal with this issue in the G-East EA. Cece said she would discuss this issue further with MPA, PCOE and members of the working group before the next meeting to come up with a plan for how to incorporate cumulative impacts into the EA. Discussions seemed to indicate that most cumulative affects for other projects could be modeled.

Next Meeting of the Upper Bay Working Group

Thursday, April 4th at 1:00, Chesapeake City Offices of the USACOE

DREDGING NEEDS AND PLACEMENT OPTION PROGRAM
UPPER BAY WORKING GROUP

April 4 1996

MEETING SUMMARY

Attendees

Jim Bailey, APG	Tammy Banta, MES
Dave Bibo, MPA	Carlyle Brown, Charter Boat Captain
Chris Brown, PCOE	Nick Carter, DNR
Barbara Conlin, PCOE	Lee Crockett, NMFS-NCBO
Visty Dalal, MDE	Cece Donovan, MES
Walter DePrefontaine, PCOE	John Gill, USFWS
Jeff Halka, DNR-MGS	Roland Limpert, DNR
Millie Ludwig, Cecil Co.	Frank Master, PCOE
John Nichols, NMFS-Oxford	Suzanne McGee, MES
Paul Slunt, Jr. DNR/PPAD	Laurence Thomas, MCBA
Steve Wampler, APG	Wayne Young, MES
Michelle Vargo, MES	

The second meeting of the Upper Bay Working Group was called to further discuss issues related to the environmental assessment of the proposed G-East open water placement area. Minutes from the Working Group Meeting of March 8, were faxed and mailed to all interested parties. No changes to the minutes have been suggested.

<u>Presentation of Updated Scopes/Schedule</u>
An updated schedule was distributed to all attendees. Tammy Banta discussed schedule changes to the scoping and quickly reviewed the implementation plan.

<u>Wildlife Studies</u>
APG was asked about the availability of wildlife data for the G-East area. Steve Wampler commented that wildlife data collected by APG stops at the Pooles Island APG Boundary. MES has investigated wildlife field data collection using aerial flyovers if suitable information is not already available.

<u>Evaluation of Near-Term Nutrient Flux</u>
Nick Carter questioned which methods were available to quantify nutrient flux directly after placement of material. Tammy referred to comments made to her by Dr. Boynton, suggesting that models could provide this information. Current field sampling methods used to quantify nutrient flux require a somewhat consolidated sample and therefore cannot be used directly after placement. Nick asked what data would be needed to run the model. MES did not have enough information concerning the model to address Nick's questions. Tammy said she would investigate the model further to determine input requirements and output information.

[Addition to Meeting Notes] - *The models referred to are the STFATE and CORMIX modules of the Army Corps of Engineers WES ADDAMS series of programs used to evaluate placement impacts on water and discharge quality. STFATE calculates plume extent and concentration of any water quality parameter using variables on existing water quality, sediment quality and hydrodynamic conditions for <u>controlled bottom placement</u>. CORMIX calculates similar information for <u>hydraulic placement</u>.*

It is believed that using the following data collection efforts, sufficient characterization of water quality impacts from sediment placement can be determined:

- *WES models for during placement impacts;*
- *sediment nutrient flux studies which cover microbially mediated nutrient fluxes from newly placed sediments in warmer months;*

- *hydrodynamic model for large scale changes relating water quality and hydrodynamics;*

and

- *water quality studies for long term changes;*

Water quality sampling was suggested as a method for determining increased nutrient flux directly after placement. Currently the water quality sampling is not done often enough. Jeff Halka believed, based on his past experience intensively looking at sediment resuspension, it would not be possible to distinguish between effects from the newly placed dredged material and locally suspended material through water quality sampling. *[Dr. Walter Boynton supports the point that water quality changes are too diffuse during placement to accurately identify impacts through field data collection efforts].*

Benthic Sampling

Visty asked whether or not the benthic sampling was adequate. John Nichols stated that the adequacy of the sampling would depend on the homogeneity of the sediments in the G-West and G-East areas. Jeff Halka thought that from his experience in the area, bottom conditions between these sites would not vary significantly. Laurence Thomas stated that the G-East bottom does vary from G-West and is covered with shell. Visty said he could provide sediment facies data to characterize the homogeneity of the sites. Also, Jeff suggested that if required, grab samples of surface sediments would be easy to collect. *[A decision on additional benthics sampling will be performed after sediment core samples are collected, this will identify whether or not substrate conditions are different enough to suggest that additional benthic samples are indicated.]*

Alternative Areas

The issue of how G-East was chosen for analysis and whether there existed any other options evolved into a lengthy discussion within the group. It was agreed that a discussion of alternative areas was a requirement of the NEPA process. PCOE described the alternative site study completed as part of the C&D Canal deepening studies. No better placement alternatives had been identified as a result of this study. The group was also reminded that many other sites had been investigated through the Placement Option Program and that this site had been singled out for implementation as a recommendation of the Management Committee, the Executive Committee and the Governor's Dredged Material Management Plan. The working group was reminded that the task at hand was to assist in developing the scoping that would be necessary to evaluate the G-East area for placement. The literature search, data collection and analysis performed as part of this environmental assessment would justify or not justify placement of dredged material at this location.

Many of the group's participants felt that an area to the south of G-West, designated Site 92 should be investigated as part of the alternatives study. Much of the group also felt that field studies may need to be added to properly evaluate the placement potential of Site 92. Having very little information about the site, PCOE agreed to look into it.

Bathymetry

Jeff Halka presented the new charts for G-East. Calculations on the site estimate the area to be approximately 375 acres. This area equates to approximately 4 to 4.5 mcy in volume maintaining a depth of -11 ft. This volume and area are for the initial rough conceptual diagram only and may change based on the EA.

Fishing Activity

Nick had previously suggested that the area be assessed for fishing activity by aerial survey. These surveys would identify the activity as commercial, recreational or charter boat fishing. He asked how often aerial flights might be flown. Tammy replied twice a month. Nick suggested twice a week, through the fishing season, approximately May through November. It was suggested that the aerial surveys be expanded to include other sites of interest for placement of dredged material.

Cumulative Impacts

PCOE, MPA and MES had met since the last meeting of the working group to discuss how to address the issue of cumulative impacts. They agreed that NEPA required they be addressed. They proposed using the hydrodynamic model to address the cumulative impact of dredged material placement projects in the Pooles Island area. It was suggested that changes in topographic diversity (fish habitat) as a result of placement be included in the discussion of impacts. MDE had previously contracted with "Coastal Resources Associates" for a study that might contain data for addressing cumulative impacts.

<u>Fisheries Data Collection</u>
Tammy reviewed methods which were discussed with Dr. Miller of Chesapeake Biological Lab, pertaining to anchored gill netting of fishes in the G-East. This methods include setting a net in G-East and one net in two different reference areas where Dr. Brandt of SUNY conducts his trawling and acoustic surveying. The current plan is that nets would be set in the evening, fish would be recovered in the morning on a 3-4 day cycle coinciding with Dr. Brandt's quarterly monitoring. There was some concern that this plan would not address the issue of fish usage of "high relief" areas. MES had addressed this with Drs. Miller and Brandt and they believed that the plan would provide data to assess large fish evading the trawls and fish usage of high relief areas. Suggestions were made to perform gill netting in the Site 92 area as well. This is under consideration. Due to the time constraints in meeting the schedule for sampling, a subgroup decided to meet on 10 April to discuss the fish sampling.

In defining the high relief areas, MES asked that the amount of gradient significant to fish be defined. John Gill and NMFS said they would try and better define that number.

The meeting of the Upper Bay Working Group scheduled for May 6th at the U.S. Army Corps of Engineers' office in Chesapeake City, Maryland has been postponed. In order to get the baseline monitoring underway for the Environmental Assessment, M.:S will be working with sub-groups to add- ;s concerns presented at the April 4th meeting.

Upper Bay Working Group Meeting: G-East/Site 92 EA
3 October 1996

Attendees:

Suzanne Hebert (MES)	Barbara Conlin (PCOE)	Frank Master (PCOE)
Cece Donovan (MES)	Tammy Banta (MES)	Chip DePrefontaine (PCOE)
Wayne Young (MES)	Dave Bibo (MPA)	Chris Judy (DNR)
John Nichols (NMFS)	John Gill (USFWS)	Jim Moore (UBCA)
Russ Green (MCBA)	Laurence Thomas (MCBA)	Nick Carter (DNR)
Bill Panageotou (MGS)	Visty Dalal (MDE)	Edie Sadler
(UMCEES/UMCEES)		
Roland Limpert (DNR)	Tom Miller (UMCEES/UMCEES)	Paul W. Slunt, Jr. (DNR/RAS)
Mike Jech (SUNY)	Walter Boynton (UMCEES/UMCEES)	Lee Crockett
(NOAA/NMFS)		
Tom Hoff (Mid-Atlantic Fish Mgmt)		

Introduction:

Ms. Tammy Banu (MES) opened the meeting with introductions of all the attendees followed by a review of the elements required in the EA and how the work is being cost shared by MPA and PCOE.

Literature Search and Review

Ms. Banta reported that the Literature Search and Review is well underway and should be completed by November 15, 1996. MES requested information from Federal and State Agencies on the listing or proposed for listing presence of rare, threatened, and endangered (RT&E) species in the G-East and Site 92 project areas. These agencies responded with no listing of RT&E species in the G-East or original concept for Site 92. MES contacted Ms. Laura Silva of NMFS who confirmed that the short-nosed sturgeon used the C&D Canal as a migration route and verified that no biological opinion or Section 7 Consultation would be necessary. <u>*Update:*</u> *As the Site 92 concept area was modified in early September, MES is currently requesting updated information from the Federal and State Agencies on RT&E species.*

Alternate Sites:

Mr. Frank Master (PCOE) presented the alternate sites that will be addressed in the EA:

<u>Alternative Sites</u>: Sparrows Point Shoreline Reclamation Site, Worton Point Beneficial Use Site, Pooles Island Area Sites: Carroll Island, Spry Island, Graces Quarters, and the Pooles Island Sites; also identified are APG-Sites, Poplar Island, Gunpowder Neck, Recycling Concept, Reclamation of mines, thin layer placement in Baltimore Harbor, Eastern Neck Island, Bear Creek Marsh, and Swan Point Marsh Creation. Ocean water and upland sites are also under consideration.

<u>Upland Disposal</u>: Three upland sites have been identified as alternatives, which for various reasons do not appear acceptable. The Hart-Miller Island site is prohibitive in terms of cost associated with transportation and material which is already destined for Hart-Miller. The Cox Creek area is not an option because it is dedicated for inner harbor materials. Lastly, a new artificial island containment facility would require 6 to 10 years preparation prior to placement and, consequently, could not be considered an option for the short term need at this time. The same reasons apply to the 19 federal upland sites, 17 of which are located within the canal proper. The other two (Courthouse Point and Pearce Creek) are within a second dredging reach in the northern approach channel. These sites would require major expansions to accommodate the southern approach channels. The availability of these sites as placement options would not occur for 4 - 6 years.

<u>Questions:</u> Mr. Bud Thomas (MCBA) asked whether the old mud dump site at Kent Island had been considered and commented that transportation to Poplar Island would be further than Kent Island.

<u>Response:</u> Mr. Wayne Young (MES) stated Site 104, along with two additional sites, is under consideration for additional dredging needs designated in the Governors Dredged Material Management Plan (DMMP). Site 104, Hart-Miller Island and Poplar Island, Mr. Master stated, are not considered viable placement options for the targeted dredging reach due to previously assigned capacities, timing,

cost, and transportation distances. Even if a new upland alternative site was found, the required construction time would extend beyond the immediate dredging need schedule. Overboard sites are what remain to be considered. Site 92 and G-East are the preferred candidates based on proximity of sites from the C&D approach channels, cost, and environmental considerations. Worton Point and Shad Battery Shoal could potentially be considered in the future.

Question: Mr. Lee Crockett (NOAA/NMFS) was concerned that Worton Point and Shad Battery Shoal remain under consideration as future placement sites for the PCOE. He believed they were not identified in the DMMP, which was supported and signed by contributing agencies.

Response: Mr. Young clarified that the DMMP identifies potential sites for a 20 year placement period. The DMMP does not preclude further consideration of other dredged material placement options such as Worton Point. If the implementation effort does not result in achieving the capacity identified in the plan, then other sites would need to be considered. Shad Battery Shoal could be one of these sites, although its ranking was low in comparison to other sites. Newly identified sites continue to be considered.

Concept Development and Design:

Mr. Chip DePrefontaine (PCOE) reported the G-East concept area is approximately 375 acres providing a capacity of 4.5 MCY. The initial Site 92 concept area (.5 MCY) was expanded in early September to reflect roughly 700 acres (4 to 5 MCY). Placement alternatives include: unconfined placement without any berm; placement with a berm constructed of dredge material (similar to G-West); and placement of a berm with a more solid construction, such as shell material or geotextile tubing. PCOE believes this third option is the best choice with respect to engineering as it would be structurally more reliable. This option is, however, the most expensive. *Update: Since this meeting PCOE established coordinates for the revised expanded Site 92 concept area. The revised expanded acreage is approximately 930 acres.*

Foundation Conditions:

Mr. DePrefontaine reported that PCOE had issued a contract to perform foundation testing. A draft data report was distributed in early September and the final report is due in late October. The EA will summarize the results of the testing and will include information on sediment type and soil shear strength. An analysis for potential consolidation after placement of material will also be performed. This, combined with MGS' information, should provide baseline data for foundation and consolidation.

Bathymetric Survey:

Mr. Bill Panageotou (MGS) reported that the water depth in G-East ranged from 4.5m to 7m (15' to 23'). The southern half of the concept area is deeper than the northern half. A depression oriented in a NE to SW direction extends beyond the boundary into deeper (10 m) waters. The deeper waters are denoted as high relief areas between G-East and G-South. Site 92 is a flat, shallow water basin oriented in a SW to NW direction. The basin extends beyond the site boundary to the NE.

Current Velocity and Bottom Shear Strength:

Mr. Panageotou reported that MGS studied the project areas under calm conditions to obtain maximum tidal velocity (not wind velocity). MGS performed their study on August 29 during a *spring tide* (a tide which occurs at or near full or new moon and causes the greatest tidal range). They spent a complete tidal cycle (13 h) at each site collecting data at five different levels in the water column. In G-East the maximum current velocity(mcv) was 37 cm/sec on the flood tide and 42 cm/sec on the ebb tide. In Site 92 the mcv was 50 cm/sec on the flood tide and 58 cm/sec on the ebb tide. Therefore, Site 92 has a stronger current than G-East. This is probably due to the flatness of the site. The charterboat captains commented that they observe tidal currents in G-East that are stronger than those reported by MGS. This could be due to enhanced wind velocities.

Bottom Sediment Substrate Characterization:

Mr. Panageotou reported that MGS collected roughly 25 samples from each of the proposed placement sites on July 12, 1996. Percent water content analysis was performed on the samples and from this bulk density at each station was calculated. A few stations covered areas of oyster shells which were fossilized oyster beds.

G-East: The water content in G-East ranged from a low 37.8% at station GE1 to a high of 62.8% at station GE2 which is a 25% variation between samples. Water content at all the other stations ranged from 45.8 to 57.8% with a variation of 12%. G-East is mainly characterized as firm mud except near Langenfelder dredging where the mud is more liquid. In G-East, the grain size falls into a clay and silt category. Overall, the sand content of the samples ranged from 2 to 16%, the silt content ranged from 46 to 70% and the clay content ranged from 18 to 51%.

Site 92: The water content in Site 92 ranged from 50.9 to 62.5% . The bulk density ranged from 1.31 to 1.45 g/cm^3. The lower central section of Site 92 is relatively softer mud. Very firm mud is characterized by bulk densities in the range of 1.35 to 1.45 and usually has a sand content of 6%.

Questions: Mr. John Gill (USFWS) asked how MGS would characterize the two sites.

Response: Mr. Panageotou said that G-East and Site 92 are all mud. This includes everything that has been disturbed by man or placed by man, which is relatively softer mud, except the berm area in G-North.

Shell Content: MGS performed a qualitative shell analysis of both G-East and Site 92. The clam *Rangia* was typically found in the top 6 to 7 cm of the core samples. In G-East most of the oyster shells were found in shallow water depths of 2.5 to 3.5 m. Regardless of water depth, shells were abundant in Site 92.

Shell Dredging:

Ms. Donovan (MES) stated that MES received a letter from DNR concerning their shell dredging operation in the G-East concept area. DNR has an existing permit issued by Baltimore District, USACE and a Water Quality Certificate from MDE for recovery of fossilized oyster shell. A map was displayed. The permit currently authorizes shell dredging in designated areas 8 and 9 until the Fall of 1998. Area 8 overlaps with the G-East concept area. If the shell dredging program continues, there would be other areas identified for use after expiration of the permit.

MES and DNR have discussed the issue of timing and the need for coordination of the two activities in G-East if a finding of no significant impact is issued on the EA. The permit allows shell dredging to occur during the period of May through September. The navigational dredging window runs from October through March. Both dredging operations typically do not span the entire permitted time. Langenfelder typically operates 2 to 3 months, depending on the volume of shells. Over the last few years, navigational dredging did not occur for longer than three months and sometimes stopped due to ice. MES will be including a discussion of the shell dredging activities in the cumulative impact section of the draft EA.

Water Quality and Benthics:

Ms. Donovan reported that MDE has conducted water quality and benthic studies in the Pooles Island area of the Bay over the last four years. MES is using this information to characterize water quality and benthics in the two study areas. Benthic samples have been collected in the Pooles Island vicinity, in G-West, G-East, and Site 92 (G-South area) areas as well as around Hart-Miller Island. A discussion developed about whether this data would be sufficient to characterize the two study sites. MES agreed to further research the historical benthics data which is available and to distribute this information to the working group members. *Update: MES prepared and distributed on 11/6/96 a letter describing the benthics data collected in the Pooles Island area.*

Sediment Nutrient Flux:

Ms. Donovan reported that Dr. Walter Boynton's group from UMCEES/UMCEES has performed sediment nutrient flux studies at G-West (for 4 years) and G-East and Site 92 (over the summer months of 1996). Dr. Boynton has worked to establish the current nutrient flux rates and has determined that the sediments are oxygenated in the summer in this area. A discussion of nutrient flux related to water quality impacts will be included in the EA.

Dr. Boynton used two sample stations each in G-East and Site 92. Additionally, data has been collected since 1988 at a reference site west of Pooles Island. Triplicate samples were collected from the sites in June, July, and August resulting in a total of 36 samples. The samples were taken during the summer, because in most areas of the bay this is when the majority of the nutrient flux is occurring. Dr. Boynton reported similar sediment bulking characteristics and fluxes for G-East and Site 92.

Nutrient flux rates were higher at G-West the summer after dredged material placement. By the second summer, the rates had decreased substantially. In the year following placement, there was more nitrogen released, but phosphorus was absorbed from the water column.

Ms. Donovan commented that the degrees of nitrogen and phosphorus release have been different depending on the method of placement. The controlled bottom placement of sediments have been observed releasing nitrogen for longer periods of *time* than the hydraulically placed material. This is thought to be true, because hydraulically placed material is mixed with the water during the dredging placement process and flushes the nitrogen at the time of placement.

Archaeological Investigation:

Mr. DePrefontaine reported that Maryland Historical Trust has reviewed the scope for the archaeological investigation and provided comments. In September, remote sensing had been completed in G-East and the initial Site 92 concept area. Remote sensing at the modified Site 92 concept was scheduled for mid October. The final report will be available in November. To the best of Mr. DePrefontaine's knowledge, there is no archeological site known at G-East or Site 92.

Hydrodynamic Modeling:

Mr. DePrefontaine reported that the hydrodynamic modeling effort was well underway. An introduction on the existing and proposed disposal area geometry was expected within two weeks. This should provide information on potential impacts to flow and circulation patterns related to disposal plans. WES is conducting the majority of work.

Cumulative Impacts:

Ms. Donovan reported that the cumulative impacts section of the EA will focus on the placement actions that have occurred in the Pooles Island vicinity. This includes both navigational and shell dredging, and the potential impacts of these on water quality, nutrients, hydrodynamics, aquatic ecosystems, aquatic organisms and physical substrates. A discussion ensued by the Working Group members on what locations and timeframe should be addressed in the Cumulative Impacts section of the EA. Ms. Donovan reported that the Pooles Island area would include areas H, D, E, F, G-West, G-South, G-North, G-Central compared to G-East and Site 92. MES will review and predict impacts from available data which has been collected over the past 20 years of placement. There are no reliable placement records dated prior to the 1970's, and monitoring was of limited significance. NEPAs standard for describing existing conditions of projected impacts is to gather data which is reasonable and relevant for the EA. The best comprehensive data collected on dredged material placement is what has been performed at G-West. MES is starting its fifth year of data collection for G-West, this will be the best data set available particularly in terms of the degree of impacts of dredged material placement to the immediate Pooles Island area.

Fisheries:

Ms. Banta reported that fish abundance, size, and species composition studies are being performed to characterize the proposed placement sites. The studies are being performed using acoustics, trawling and gill nets. Acoustic and trawling studies are being performed by Dr. Brandt's group from SUNY and have been performed in G-West and reference areas over the last four years. The G-West and reference areas A, B, and C, encompass G-East and half of Site 92. Gill net studies are performed by Dr. Miller from UMCEES.

<u>Acoustic and Trawl Studies:</u> Dr. Mike Jech reported that SUNY typically conducts six acoustic transects in each area (eight in Area B). They also perform a 24 hour bottom trawl series, a 12 hour mid-water trawl series and acoustics day and night. This work is conducted on a quarterly basis. In April 1996, 70-90% of the fish observed were white perch. In June, white perch were prevalent as well as clupeids (possibly due to the influx of fresh water this spring). Very few anchovies were observed.

Typically SUNY acoustically detects more fish at night, because the fish move from the bottom into mid water.

Fisheries Usage of High Relief Areas: MES had previously requested that Dr. Brandt review acoustic and trawls data to investigate fi.' usage in areas of higher relief versus lower relief. Dr. Jech reported that a cursory examination did not reveal much of a difference in the total number of fish distributed over sloped areas versus low relief areas. He stated that before a thorough study could be performed, definitions of high relief, low relief, deep holes and shallow holes would be required. The comparison does appear to be feasible using acoustic data, however.

Comments: Dr. Boynton discussed that the National Science Foundation is supporting a six year project through the Land Margin Ecosystem Research Program. The focus of this study is to try to understand secondary production in the Chesapeake Bay ecosystem. This year, two weeks were spent in the turbidity maximum area of the Upper Bay. Mid-water trawls and acoustics were performed in the Pooles Island area. Data collected includes water quality, phytoplankton, zooplankton, and fisheries information. In February, they are hoping to have some of the data assimilated.

Gill Net Studies: Dr. Tom Miller presented the objectives of the gill net study which include: characterization of low and high relief areas with respect to the fish community they support; comparison of the usage of these areas across the season; and inter-calibration of acoustic and gill net data. UMCEES is performing the gill net sampling quarterly over a year period and covers the same sites sampled by Dr. Brandt. Multipanel experimental gill nets are being used with mesh sizes ranging from 3 to 8 inches. Each net is 8 feet deep, anchored at either end, and is fished at slack tide for approximately 2 hours. The study focuses on target species which are important to the recreational fishery. Subsamples of fish are taken for age composition and dietary analysis. All fish are counted and selected species are measured and weighed as well.

During the July gill net study, approximately 1500 fish from ten separate species were processed, with menhaden dominating the catch. Wide size ranges of fish caught existed, reflecting the range of the mesh size deployed. Gill nets set in G-East captured more menhaden than other sites. Striped bass caught in G-East were statistically smaller than those caught in other areas, with an intermediate catch per unit effort (CPUE) for this species. In terms of abundance with respect to relief within G-East, striped bass were statistically more abundant at high relief sites. The biological significance of this is unknown.

Fishing Activity:

Dr. Miller discussed the various methods available to assess the direct importance of the disposal sites to the recreational fisheries and the pro's and con's associated with each. He explained the methodology UMCEES will use which combines both the recreational fisheries and the commercial fisheries. A weighting scheme will be used to correlate the Pooles Island area to the overall commercial and recreational fisheries in NOAA area 025. The weighting scheme will be based on the distance from the fisherman's home port to Pooles Island. UMCEES will use the NMFS Marine Recreational Fisheries Survey which has been conducted over the last 16 or 17 years and commercial data obtained by DNR.

Angling Survey: Dr. Miller explained the various options available in designing the angling survey. These options ranged from a level of high control (on gear, boats, sites) to a lower level of control where only the sites were controlled. Dr. Miller and MES met with resource and regulatory agencies and charterboat captains to design the angling survey and determine the appropriate reference areas that should be used. The option chosen by the group establishes CPUE rates in G-East, Site 92, and two reference areas (Blackstone and Alpha) based on catch-per-rod-per-minute. (A map was displayed.)

MES and Dr. Miller interviewed all the charterboat captains before hand and devised a weighting scheme based on the type of gear used and tide to fish. Gear type, tide, and captains were randomly assigned to each day. For example, a charterboat captain might troll the Blackstone area for an entire ebb tide. Each other captain for that day fished the same gear and tide but at one of the other sites. Within these parameters, the captains were encouraged to fish hard and free. The experiment was started on August 24 and runs through October 30, 1996. Within this time period there are sixteen fishing days, to this date ten days have been completed.

Dr. Miller reported that over the first 7 days of the angling survey, 3 striped bass were caught in Site 92, 22 in G-East, 63 in Alpha, and 59 in Blackstone. This information will be standardized in terms of CPUE or strikes per unit effort (SPUE). G-East had an equally high number of SPUE, but much lower CPUE. The first four days of the study occurred prior to the striped bass season opening and therefore, there were few boats fishing these areas. There was no apparent change in catch rates prior to and after the striped bass season opened. Dr. Miller reported that although the numbers are fairly even throughout the sites, there were daily variations. Catch rates per site varied, although Site 92 CPUE remained low. MES recorded the geographic coordinates of each catch with GPS units. This may provide additional insight into the fish distribution in terms of bottom conformation.

Comments: Mr. John Gill stated the USFWS wanted an aerial survey performed to characterize how many recreational fishermen and private boaters use the Pooles Island area for inclusion in the EA. *Update: DNR performed an aerial survey of the Pooles Island area during the Fall Striped Bass season of 1992. This information will be included in the EA, in addition to the angling survey and the NMFS and DNR data set analysis.*

Status of the Environmental Assessment:

Ms. Banta (MES) reported that the EA is approximately 40% complete and the draft EA is due out by mid January.

Future Meetings:

The next meeting of the Upper Bay Working Group is scheduled for Tuesday, December 10, 1996 from 1:00 to 3:00 p.m. at the US Corps of Engineers building in Chesapeake City, MD.

Upper Bay Working Group Meeting: G-East/Site 92 EA
Meeting Summary
10 December 1996

Attendees:

Dave Bibo (MPA)	Barbara Conlin (PCOE)	Millie Ludwig (Cecil Co.)
Wayne Young (MES)	Jeff Gebert (PCOE)	Roland Limpert (DNR)
Cece Donovan (MES)	Chris Brown (PCOE)	Jeff Halka (DNR/MGS)
Tammy Banta (MES)	Jim Bailey (APG)	Nick Carter (DNR)
Suzanne Hebert (MES)	Russ Green (MCBA)	Paul W. Slunt, Jr. (DNR/RAS)
Jennifer Duff (MES)	Carlyle Brown (MCBA)	Brigitte Farren (EPA)
John Nichols (NMFS)	Mike Jech (SUNY)	
Walter Boynton (UMCEES/UMCEES)		

Introduction:
Ms. Tammy Banta (MES) welcomed attendees to the meeting and announced that this would be the last working group meeting before the draft EA is completed. She requested corrections or comments to the October 3 meeting minutes; there were none. *Update: Another meeting has been called to update the working group on the status of the EA. This meeting will be held at 1 pm on February 5, 1997 at MPA.*

Literature Search and Review:
Ms. Banta reported that the Literature Search and Review was almost complete. MES requested information from Federal and State Agencies on the listing or proposed for listing presence of rare, threatened, and endangered (RT&E) species in the G-East and Site 92 project areas. These agencies responded with no listing of RT&E species in the G-East or Site 92 concept areas. MES contacted Mr. John Nichols of NMFS who confirmed that the shortnose sturgeon used the C&D Canal as a migration route and that no Section 7 consultation or biological opinion were necessary. *Update: The NMFS is forwarding a letter to MES concerning the presence of the shortnose sturgeon in the study areas.*

Concept Development and Design:
Mr. Chris Brown (PCOE) presented the following dredged material placement concepts for both G-East and Site 92:

Alternate 1: Unconfined placement by hopper dredge within existing contours of each site. This alternate was not suggested due to potential material movement from each site into adjacent high relief areas.

Alternate 2: Creation of a subaqueous berm at each site using geotubes to restrict material movement from reaching adjacent high relief areas. This alternate was not suggested due to excessive costs associated with use of the geotubes.

Alternate 3: Creation of a subaqueous berm at each site using dredged material to restrict material movement from reaching adjacent high relief areas.

Alternate 4: Creation of a subaqueous berm at each site using a dredged material and shell material mixture to restrict material movement from reaching adjacent high relief areas. This alternate appeared desirable due to its resistance to erosive forces and as desirable substrate for benthic re-population.

Mr. Brown reported that neither site could be filled to -11 feet mean lower low water (MLLW). Site elevations of -14 to -16 feet MLLW were feasible with minimal material migration. Mr. Brown then presented the concepts for Site 92 and G-East.

Site 92: To avoid material movement into high relief areas, a subaqueous berm would be placed on the northeastern corner of the site. The berm would be approximately 3,000 feet long and 30 feet wide with a top elevation of -14 feet MLLW. The berm would have a variable slope depending on depth. The volume of material used to create the berm would vary depending on the type of material used. For instance, if a dredged material and shell mixture were used, less material would be required to construct

the berm and the berm slopes would be steeper. If dredged material were used, more material would be used and the berm slopes would be more gentle. The estimated capacity of this site would be 4 MCY.
Update: Due to the planned placement of approximately 900,000 CY of dredged material into existing placement area G-South this year, the estimated capacity of Site 92 has been reduced to approximately 3.5 MCY. This is because the Site 92 concept overlaps with a portion of the G-South placement area.

G-East: To avoid material movement into high relief areas, a subaqueous berm would be placed on the southern edge of the site oriented in an east to west direction. The berm would be approximately 2,800 feet long and 30 feet wide. The capacity of this site would be 1.5-2 MCY, following the -15 feet contour. The shell/dredged material mixture was also recommended for this berm.
Update: Due to results of the charter boat angling survey, the G-East concept has been reconfigured to avoid the area of high relief on the northeastern edge of the site. The estimated capacity is now 1.2 MCY.
Question: John Nichols asked if DNR had rights to the shells.
Response: Mr. Brown did not know.
Question: Jeff Halka asked whether the material in the shell concept would be a mixture of shells and dredged material
Response: The berm would consist of a mixture of dredged material and shell. This mixture would make the berm more stable.
Update: MES discussed the availability of the shell material for berm construction with DNR in January. The estimated volume of material required to create the berms is roughly over half of that used by the DNR oyster shell dredge program in a one year period. Therefore, use of this material is unlikely.
NOTE: Due to the lack of capacity at either site to meet the minimum 4.5 MCY need, both sites would be proposed for use. Cumulatively they would provide approximately 4.7 MCY of capacity.

Foundation Conditions:
Mr. Chris Brown reported that settlement of the berm and subgrade could be 8 to 12 inches within five years. To prevent loss of capacity due to settlement, the berm should be built higher.
Question: Paul Slunt inquired if there was firmer material under the sandy material.
Response: Chris Brown responded that they had not done extremely deep borings but the sandy material could go down several hundred feet.
Question: Mr. Slunt asked what Mr. Brown had based his assumptions on in determining the amount of consolidation.
Response: Mr. Brown had used material properties of the subgrade and thickness of the soft sediment to calculate the consolidation. The 8 to 12 inches could be an under-restimation.
Question: Wayne Young asked if alternate material, such as coarse sand from other channels such as Long Creek, could be found if the DNR had claim to the shell material at the sites.
Response: Mr. Brown responded that the transportation costs in using alternative material could be prohibitive though technically feasible. Upland sites may be a problem because they have become overgrown since they are no longer in use. The costs of transporting material by hopper dredge from the channels would have to be considered.
Mr. Nichols requested that Mr. Brown cost out the material alternative suggested by Mr. Young in case the shell was not available.

Bathymetric Surveys, Bottom Substrate Characterization and Current Velocity:
Mr. Halka gave a brief report on the bathymetry, bottom substrate characterization and current velocity studies of the sites, referring to the details reported by Mr. Panageotou during the October 3 working group meeting and summary in the 10/3/96 minutes. There were no questions on this topic.

Sediment Nutrient Flux:
Dr. Boynton provided an overview of his findings for both sites. Most of the fluxes seem to be occurring in June, July and August. Though the sediment oxygen consumption rates are large compared to other zones in the bay, the high rates do not appear to pose a threat to oxygen conditions because the water column in this area is well-mixed. The oxygen consumption rate at G-East and Site 92 was similar

to the reference sites. The phosphorous fluxes were similar to those of reference sites and are low. The silica fluxes are characteristic of the upper Bay. Ammonia releases in June were higher than in the reference areas. The nitrite and nitrate rates were small and directed into the sediment. These rates were not deemed large enough to impact water quality. Comparisons with external nutrient sources indicate that sediments represent a small to modest internal source of nitrogen in all three areas. However, he concluded that fluxes within the sites were relatively low for the Bay in general and that the site characteristics were consistent with what would be expected in the upper Bay.

Archaeological Investigation:
Tammy Banta reported that two submerged targets that exhibit shipwreck characteristics were identified within the G-East and Site 92 project area and that a dive will be conducted to evaluate the sites. The report on the findings will be submitted to Maryland Historical Trust for review and comment prior to inclusion in the final EA.

Hydrodynamic Modeling:
Jeff Gebert reported on the model plan that consisted of base conditions with elevated bathymetry in the two study areas. The model was developed using data on tides and inflow from the Susquehanna River. The process used existing conditions on the site, distributed 4-5 MCY of material over the areas, identified node points for the grid, and used close to peak flood tide conditions. The two sites have only negligible differences hydrodynamically with the introduction of material.
Question: Mr. Carter asked how a 4 foot thickness of material could be used if the two sites are different sizes.
Response: The maximum thickness is comparable. The sizes and quantities of material differ in the two sites.
Question: Mr. Halka asked what velocities were used in the model.
Response: Mr. Gebert responded that spring tide were used and that the velocities were model generated.
Question: Carlyle Brown mentioned that higher velocities are know to occur in the area.
Response: The range of the velocities used accommodate higher velocities. The purpose of the model is to give an indication of the change that will occur from depositing material. In this case the changes bordered on undetectable.
Question: Carlyle asked if the model could indicate scouring as would be expected with water velocities of 1.5 to 2 feet/second.
Response: The model does not increase or decrease velocity to favor deposition or scouring.

Update: The model is being re-run for Site 92, as it was run on the original smaller concept. The results of the final model for the expanded Site 92 concept will be included in the Final EA.

Benthics:
Tammy Banta reported that in reference to questions raised during the last meeting, MES agreed to write a letter report on the historical benthic data collected in the Pooles Island vicinity and how the benthics would be characterized in the EA. This letter was distributed to Working Group members on 11/6/96. Additional copies were distributed at this meeting. There were no comments or discussion concerning this topic. *Update: Benthic studies of the G-South placement area in 1996, indicate that the benthic community was healthy and had met the Restoration Goals Index and Index of Biotic Integrity. The G-South area was last used as a placement site in 1993. Roughly half of this site is included in the Site 92 concept area. Benthic studies in and around area G-East in 1995 indicate that this community was healthy and had also met the RGI and IBI. If a finding of no significant impact (FONSI) is issued for use of the sites, then additional benthic baseline monitoring would be performed.*

Fish Abundance, Size & Species Composition:
Dr. Mike Jech described the studies conducted at the reference and study sites. Acoustic transects were performed during the day and night in midwater and bottom water. The December cruise was currently being performed. Data from this cruise will allow for an examination of inter-annual differences, inter-area differences, and the impact of fresh water influx which occurred this past spring. To summarize

differences seen thus far, there were more blueback herring and Alosid species, and fewer anchovy than were caught in the spring and summer. During the October cruise, anchovy abundances returned to levels observed for herring.

Suzanne Hebert discussed the studies being conducted by Dr. Miller of UMCEES. There is a hypothesis that the larger fish species have been evading the trawl studies performed by SUNY. Dr. Miller has been using anchored gillnets to evaluate this hypothesis. After two quarters of research he found that the size of striped bass caught were directly related to the size of the mesh; however, no striped bass were caught in the 7" and 8" size mesh. Therefore, the net avoidance by larger fish may not have been a problem and the size distribution may be an accurate description of the fish in the area.
The greatest average size of striped bass were observed in Site 92 and the lowest in G-East. The dominant fish species captured have been white perch, striped bass, catfish and menhaden. Menhaden dominated the July catch, contributing 74% to abundance and 61% by weight. Menhaden and gizzard shad dominated the October catch, contributing 80% to abundance and 72% by weight. In comparison, striped bass captured in October contributed 7% to the abundance and 19% by weight.
Striped bass catch per unit effort (CPUE) during the July sampling period in the higher relief areas was higher in terms of abundance but not weight indicating that smaller striped bass were captured in the area. There was no statistically significant differences in other species in captured in higher relief areas. The CPUE in October was greater in lower relief sites; however, not significantly so. Site 92 had the greatest CPUE in October even though the catch was half of the July catch for all sites except Site 92.

Fishing Activity:
Tammy Banta reported that Dr. Miller is working on the data set analysis of the commercial and recreational fisheries. The aerial survey performed by DNR during the 1992 Fall striped bass season will be incorporated into the EA. Suzanne Hebert reported the draft angling fishing results. These results indicated that the reference sites Alpha and Blackstone had the highest CPUE, followed by G-East and then Site 92. *Update: The final results of the fishing activity study indicate that Alpha had the highest CPUE (1.3) of the four sites followed by Blackstone (1.19), G-East (.54) and Site 92 (0.078).*

<u>Closing Comments:</u>
Tammy Banta reported the draft EA will be completed by January 15, 1997 and the comment period would be 30 or 45 days. *Update: The target date for distribution of the draft EA has been moved to February 17, 1997. The comment period will be 30 days.*

Upper Bay Working Group Meeting: G-East/Site 92 EA
Meeting Summary
5 February 1996

Attendees:

Dave Bibo (MPA)	Barbara Conlin (PCOE)	Nick Carter (DNR)
Wayne Young (MES)	Walter DePrefontaine (PCOE)	Roland Limpert (DNR)
Cece Donovan (MES)	John Gill (USFWS)	Bill Panageotou(DNR/MGS)
Tammy Banta (MES)	John Nichols (NMFS)	Paul W. Slunt, Jr.(DNR/RAS)
Suzanne Hebert (MES)	Russ Green (MCBA)	Chris Judy (DNR)
Jennifer Duff (MES)	Laurence Thomas (MCBA)	Narendra Panday (MDE)
Edie Sadler (UMCEES)		Tim Rule (MDE)

Introduction:
Mr. Bibo opened the meeting and requested that the attendees introduce themselves. The first order of business involved a review of the 10 December 1996 meeting minutes, clarification of any uncertainties and an announcement of updates since the meeting.

Literature Search and Review:
The lack of knowledge concerning the status of the shortnose sturgeon in the upper Bay has delayed a formal response from the NMFS. To date, the NMFS has sent a response to the regional office for their review. Mr. Nichols, speaking on behalf of NMFS, relayed to the working group the contents of the letter which generally stated the following: NMFS has limited information on the shortnose sturgeon at this time, therefore, they can not make a determination on the status of this species; and NMFS is encouraging efforts to gather information on this species through surveys or genetic studies. To date, 8 shortnose sturgeon captured in the Upper Bay have been reported to the Annapolis office of the USFWS. Mr. Gill, added that USFWS and APG are proposing to conduct a study of the shortnose and Atlantic sturgeon. This study is slated to begin Spring '97 dependent on funding. This project will involve intensive sampling. Fish will be sonic tagged and a side-scan sonar will profile the sediment within Aberdeen and potential placement areas. *Update: PCOE has received the letter sent by the NMFS regional office in Gloucester, MA.*

Status of the EA Schedule:
Ms. Conlin described the NEPA process for the Environmental Assessment (EA). At the time of the meeting, the EA was in internal review at MPA and PCOE. The MPA and PCOE will provide edits for incorporation by MES. The draft would then be distributed to interested parties by February 17 along with a Public Notice to the states of Maryland, Delaware, and Pennsylvania. The draft EA will have a 30 day comment period. The target date for the final EA is April 30, 1997. Mr. Panday questioned whether the working group would review the draft EA prior to its public review. Ms. Donovan explained that the document was in internal review with the PCOE and MPA. She further stated that concerns voiced by the working group since the beginning of the project have been incorporated into the draft. Therefore, the EA would go to the working group at the same time it goes to the general public. *Update: MES has received and has incorporated comments from the MPA and PCOE. A revised pre-draft has been sent for their review. The exact distribution date of the draft will depend on the volume of edits received. It is currently estimated that the draft will be distributed during the first week of March.*

Shell Dredging:
Ms. Donovan described the status of coordination with the fossil shell dredging activities. There are currently three areas permitted and six areas have been previously permitted for fossil shell dredging in the upper Bay. Meetings with DNR have shown that dredged material placement can be coordinated so as to not interfere with shell dredging activities. Total shell dredge acreage was identified as 10,480 acres. There are currently 4,681 acres permitted, of which 885 acres have been dredged to date. The

total acres dredged since 1960 is 1,075 (this includes the currently permitted areas). The volume of shell dredged material needed for berm construction exceeds the annual total dredged; therefore, it is not likely that shell dredge material will be utilized for berm construction. Instead it is likely that bottom release scow techniques will be used. Total acreage of navigation dredged material open water placement areas used since 1964 is estimated at 1,778 acres. *Update: This does not include: sidecasting areas, which did not have recordkeeping of acreages; areas A, B or C; and side slope acreages of the open water placement sites, which in some cases extends outside of the designated placement areas. This estimate does include existing areas D, E, F, G-North, Central, South and West, and proposed areas G-East and Site 92.*

Mr. Panday questioned whether sandy material could be used for berm construction and if it may be possible to use *new work* material from the Baltimore channels. Mr. Bibo responded that if sand were desirable for use, it would depend on the dredging scheduling and material availability. Ms. Donovan commented that this idea could be investigated. Mr. Nichols asked if berm creation was for the purpose of creating fish habitat. Ms. Donovan stated the primary purpose would be for sediment retention. Mr. Nichols asked whether areas dredged for shell dredging would be filled during the dredged material placement activities. Ms. Donovan replied that Ms. Banta would address this concern momentarily.

Mr. Carter asked whether the estimated acreage of material placed in the upper Bay included Area H. Ms. Donovan replied that it did not. Mr. DePrefontaine suggested that Jeff Gebert of PCOE might be able to provide this information. Mr. Carter stated that he was interested in records prior to 1964 and would like to see annual volume estimates presented in the EA. Ms. Conlin stated that the PCOE has records of dredged material placement which occurred from 1940 through 1960, this placement was thought to be approximately 50% overboard and 50% upland. Mr. Carter asked if there was a time when the annual volumes dredged were lower. Ms. Conlin recalled that prior to the channel deepening (1965 to 1968) less material was dredged.

Mr. Thomas commented on the shell dredging which excavated an area off "Baltimore Light"; known to the charterboat captains as "steak reef." Mr. Thomas believed 1,000 acres of shell bottom were taken away.

Monitoring in Pooles Island:

Ms. Donovan gave an update of the proposed monitoring for G-East and Site 92. The monitoring would include site management, consolidation and erosion studies. In addition, MES will be receiving guidance from MDE pertaining to water quality monitoring as well as follow-up monitoring of benthic recolonization.

Hydrodynamic Modeling:

Mr. DePrefontaine reported that the hydrodynamic modeling work completed for Site 92 was performed on the original concept area, not the expanded area. Mr. DePrefontaine stated that per discussions with Mr. Gebert (PCOE) a model rerun on the expanded area was not likely to show changes in the results. *Update: Although the results were not expected to change, PCOE will re-run the model on Site 92. This information will be presented in the Final EA.* Mr. Panday commented that the hydrodynamic model does not provide information on material movement but provides information on the potential change in the current velocity and direction. The potential for sediment transport is determined by an engineer through evaluation of the model results and the sediment composition.

Reconfiguration of G-East/ Results of Charter Boat Angling Survey:

Ms. Banta reiterated results of the charter boat angling survey that were presented at the last meeting. The two reference areas, Alpha and Blackstone, exhibited the highest CPUE for striped bass, with G-East and Site 92 ranking third and fourth. The CPUE for the areas were as follows: Alpha 1.3, Blackstone 1.19, G-East 0.54 and Site 92 - 0.078. Although G-East ranked third overall in the CPUE, a closer examination of the distribution of the catches revealed that approximately 86% of the striped bass captured in the site came from areas of high relief. The majority of the fish captured were from an area of high relief on the northeastern corner of the site. Due to the productivity of this area, it has been eliminated from the site configuration. Bottom release scows will be used to place material in front of the northeastern area of high relief, thereby avoiding material transport to this area. Bottom release scows will also be used on the eastern edge of the site to avoid material transport off site. As previously discussed, a berm will still be placed on the southern edge of the site. Placement of material in G-East will be by hydraulic or bottom release scow methods, as the material placed on the northern, eastern and southern edges of the site will prevent material transport into the high relief areas. Avoidance of this area of high relief, also largely reduces the conflict with DNR's shell dredging program in this area. Mr. Carter complimented the PCOE and MPA for reconfiguring the site to avoid this area of high relief. *Update: The CPUE's for the charter boat angling study are presented below with appropriate units of measurement, as they were reported in the meeting and in the more commonly described unit of catch per hour.*

Study Area	*catch/rod/minute x 1000*	*catch/hour*
Alpha	*1.3*	*0.078*
Blackstone	*1.19*	*0.0714*
G-East	*0.54*	*0.0324*
Site 92	*0.078*	*0.0047*

Ms. Banta further commented that a meeting will be held with the charter boat captains and other interested parties to discuss results of the angling survey. This meeting will be scheduled after the draft EA is distributed for public review. Mr. Nick Carter requested copies of the raw data used to generate the gillnetting and fishing activity sections of the EA. *Update: This information will become available upon receipt of the final gillnetting and fishing activity reports from UMCEES. Written requests for results of any of the studies performed under contract to MES should be sent to Ms. Donovan.*

Capacity of Sites and Needs of the Proposed Action:
Ms. Banta stated that at the last working group meeting, PCOE presented the concept design of the two sites and the available capacities. With a berm placed on the northeastern corner of the site, Site 92 was estimated to provide approximately 4 MCY of capacity when brought up to elevation -14 feet MLLW. With a berm placed on the southern edge of the site, G-East was estimated to provide approximately 1.5 MCY of capacity when brought up to elevation -16 feet MLLW. Since that time, we have learned that approximately 900,000 cy of material was earmarked for placement in permitted area G-South this year. This area overlaps with Site 92. Thus, the estimated capacity of 4 MCY for Site 92 has been reduced to approximately 3.5 MCY. Due to results of the charter boat angling survey, G-East was reconfigured to exclude the area of high relief in the northeastern edge of the site. Thus, the estimated capacity of G-East has been reduced from 1.5 MCY to 1.2 MCY. As neither site supports the needed of 4.5 MCY, both Site 92 and the reconfigured G-East would be used if a FONSI is issued. Mr. Panageotou reported that based upon discussions held at a site management meeting for G-West, approximately 400,000-500,000 cubic yards of material would be placed in G-South this year. This is less than the anticipated 900,000 cubic yards, thus the Site 92 capacity would be approximately 3.7 million cubic yards instead of 3.5.

Mr. Paul Slunt, Jr. asked if a cost-benefit analysis had been run for G-East due to the minimal placement capacity. Mr. DePrefontaine stated that no formal cost-benefit analysis had been performed, but that approximately 1-1.2 mcy of placement was needed for each dredging season. G-East would provide capacity for at least one season. Mr. Wayne Young added that the cost of berm construction was minimal.

Mr. Gill asked what the PCOE and MPA would have done if Site 92 had not been suggested during one of the working group meeting, after knowing now that G-East does not hold sufficient capacity on its own. Ms. Donovan replied that without Site 92, there would not have been sufficient capacity to meet the need. Mr. Gill requested that MES put in writing the reasoning behind why the sites were reduced in capacity. *Update: This logic is explained in Section 2 of the draft EA.* Mr. Gill asked what the proposed placement schedule for the areas would be. Mr. DePrefontaine replied the first phase would be berm creation followed by placement in Site 92. Mr. Gill wondered if a berm placed without material placed behind it is stable. Mr. DePrefontaine replied that it may be an option that placement in G-East would be bottom release scow placement only. Mr. Panageotou asked whether the footprint of the berms as presented in the figures were for the top or bottom of the berm. Ms. Conlin replied that they were the bottom of the berms.

Additional Comments:
Mr. Thomas stated for the record that the Upper Bay Charter Boat Captain's Association was opposed to open-water placement. He further stated that he was not confident that berms retain material and would prefer to see contained facilities, such as Hart-Miller Island used for dredged material placement. Mr. Bibo commented that a reduction in the elevation of the placement areas was attributed to material consolidation, not just erosion.

Mr. Carter suggested that the currently discussed Brownfields legislation should be considered for upland disposal. (*Note: Brownfields are inner city areas which are or may be contaminated from previous industrial or other activities. In many cases these areas are abandoned or otherwise unproductive. Certain initiatives have been proposed to reduce or eliminate new property owner liability for clean up if the sites can be returned to some type of use.)* Mr. Panday commented that use of the Brownfields for dredged material placement is unlikely. Mr. Young added that there was much uncertainty surrounding the composition of material in the Brownfields areas.

Charter Boat Angling Study: G-East/Site 92 EA
Meeting Summary
25 March 1996

Attendees:

Dave Bibo (MPA)	Dr. Thomas Miller (UMCEES)	Russell Green (MCBA)
Wayne Young (MES)	Bill Thompson (MCBA)	Derek Orner (NOAA-CBO)
Tammy Banta (MES)	Carlyle Brown (Charter Boat Capt.)	John Gill (USFWS)
Suzanne Hebert (MES)	Mark Brown (Charter Boat Capt.)	Nick Carter (DNR)

Introduction:
Ms. Banta welcomed the attendees and stated that the purpose of the meeting was to have Dr. Miller present the findings of the charter boat angling survey to the attendees and answer any questions posed. Ms. Banta stated that the Draft Environmental Assessment (EA) for G-East/Site 92 was distributed to the public on March 10th. Any comments should be submitted to the Philadelphia Army Corps of Engineers by April 15th. Comments received will be addressed and the edited EA will be sent to the District Engineer at the USACE by April 30th.

Reconfiguration of G-East
Ms. Banta briefly mentioned that findings of the charter boat angling survey resulted in the reconfiguration of the proposed G-East area. Although G-East ranked third overall in the catch per unit effort (CPUE), a closer examination of the distribution of the catches revealed that the majority of the fish were captured from an area of high relief in the northeastern corner of the site. Due to the productivity of this area, G-East has been reconfigured to eliminate the northern portion of the site.

Presentation of Charter Boat Angling Study by Dr. Miller
Dr. Miller began his discussion of the angling study by reviewing the process through which the study was designed. The purpose of the study was to develop a way to assess the fishery in general and the importance of the two proposed placement areas, G-East and Site 92. Five options were discussed during three survey design meetings held in August, 1996 with the charter boat captains and representatives of DNR, NMFS and USFWS. These options included the following: 1)Off-Site Method; 2) On-Site Intercept, 3) Roving Creel Census, 4) Aerial Fishing Survey, and 5) Fishing Experiment.

There were many pros and cons to consider for each method described by Dr. Miller. Option 1, the off-site method consists of utilizing data collected by phone, typically a random dial situation. This method, in conjunction with the 2nd option which interviews fishers as they exit their access sites, is used by the National Marine Fisheries Service, Marine Recreational Fisheries Statistical Survey (data collected through this survey was analyzed and is presented in the EA). The 3rd option, a roving creel survey is valuable to identify the specific catch at known popular fishing locations where the interviewer intercepts the fisher on the fishing grounds. The drawback to this survey (for the purpose of the EA) is that Site 92 is not considered a typical fishing area and there would likely be zero boats from which an assessment could be drawn. The 4th survey, an aerial survey provides very precise information about the distribution of boats, but to get an idea of catch rates it would need to be combined with one of the previously mentioned surveys.

All of these options, while providing information about number of boats or catches of fish, would not generate precise information about the location of catch, whether in the proposed placement site or elsewhere. Therefore, considering the many aspects of each option, the group chose to conduct the 5th option, a fishing experiment, where the fishing activity in the Pooles Island area could be mimicked to assess the fishing in the area.

This fishing experiment allowed for design of a study which enabled replicate sampling and provided data for statistical analysis of catch. The fishing experiment consisted of designated sites (the proposed placement sites: G-East and Site 92 and 2 reference sites: Alpha and Blackstone), one boat per site per day, and randomly assigned tidal cycle and gear types to be fished on each of the 16 non-consecutive fishing days chosen. Conducted during the Fall recreational fishing season, the experiment may not have direct bearing on fishing experience in other seasons of the year; however it should estimate year round fishing conditions.

Summary Of Strike And Catch Data Presented By Dr. Miller

Area	Total Number of Strikes	Total Number of Catch	Total Hours Fished	Strikes (fish/fisher/hour)	Catch (fish/fisher/hour)
Site 92	32	6	265.5	0.12	0.02
G-East	274	43	283.66	0.97	0.15
Blackstone	267	89	236.5	1.13	0.36
Alpha	248	98	301.3	0.82	0.37

Dr. Miller summarized the data, mentioning the reference sites were more productive overall than either proposed placement area. He commented that the average catch rates in Blackstone and Alpha were statistically similar to one another, yet different from G-East and different from Site 92. The catches for G-East and Site 92 were statistically independent from each other and the two reference sites. In terms of size variation, there was little difference in size of fish captured at any of the sites. Mr. Carlyle Brown commented he did not feel the volume of fish caught during the fall fishing season was representative of past or typical fishing seasons. He believed it was a bad season for striped bass in the upper bay.

Effect Of Tidal State To Catch

Dr. Miller presented figures representing the catch rates of striped bass and strike rates *for all species* per the tidal state. In order to present the data, he designated portions of the ebb and flood tides on a vertical scale reading from -1 to 0 to 1 and plotted this over days of the study. For example, at 0 the tide is slack, above 0 the tide is flooding, and below the 0 the tide would be ebbing. For the most part, the strike rate was distributed throughout the entire tidal cycle whether it was flood or ebb at all sites. However, while the overall striped bass catch rates across the tide were steady, the striped bass catch in relation to ebb or flood time varied according to site. For instance, in Blackstone, striped bass were captured more often on flood tides than ebb tides and in both Alpha and G-East they were captured primarily on the ebb tides. Catches were prohibitively low in Site 92 to evaluate the tidal effect.

Dr. Miller mentioned there was little difference in the strike per unit effort (SPUE) and CPUE results between the different ebb and flood tides. Mr. C.Brown wondered if the tidal analysis compared the catch in terms of spring versus neap tide, adding that the currents he has witnessed in the immediate Pooles Island area during these tides are stronger than other areas such as Blackstone. Dr. Miller commented that he had not delineated the data this way but could do so.

Mr. C.Brown stated he was surprised that catches were occurring nearly uniformly across the tides. In the past he has observed more catches in the early and later stages of the tide, and that typically it seemed there was a lull in activity during the middle of the tide. In fact, while fishing during periods of high tidal current, he was uncertain whether the lack of fishing activity was a result of the actual current or turbidity increased due to the disturbance of the mud bottom as a result of the current.

Effects of Relief on Fishing Success

Dr. Miller provided a depiction of the catch in G-East on a contour map. Fish capture in G-East occurred primarily in an area of high relief in the northeastern portion of the original site. The contours indicated higher catch rates primarily on the ridges of G-East in this area. Due to the productivity, this area was eliminated from the proposed placement configuration.

Dr. Miller commented that similar results were observed in Blackstone, where the catches were concentrated on 2 ridges shown by two humped regions on the contoured map. Mr. C. Brown stated that he has captured fish in other areas of Blackstone and believed that due to oyster shell dredging in the area the bathymetry has changed over time. Dr. Miller stated that while recent bathymetric data was available for the other areas, the information for Blackstone was taken from NOAA charts and may not be the most current bathymetric information.

Dr. Miller displayed the bathymetry for Alpha and stated that higher catches of striped bass appeared to occur in restricted regions within this site as well within G-East and Blackstone. Dr. Miller warned it was difficult to define relief or quantify it in terms of slope as the bathymetry available for the sites varied in scale and date of survey. Mr. Carlyle Brown commented that the areas he has captured fish in are different that what was depicted in this study. He thought that it may be due to the low water clarity observed in the upper Bay during the angling study. Mr. Thompson agreed and suggested that such studies ought to be conducted over an extended period of time. Dr. Miller added that although the information presented best describes the conditions at the time of the study, for the most part he believes the overall conclusions would hold.

Questions or comments regarding Angling Study
Mr. Thompson, speaking, he believed, on behalf of the other charter boat captains involved in the study, expressed concern that if the purpose of the study was to catch as many fish as possible, the study design did not allow this. He was referring primarily to the restriction placed on each captain to fish a particular gear type each day as opposed to choosing the best gear type once tide and other environmental conditions were evaluated. Dr. Miller replied that, if each captain were allowed to fish individual gear types independent of the other charterboat captains, too many variables in the data would be introduced. He relayed an example of a particular study day where the captains were not in agreement on which gear type they should use. Considering the effect of standardized gear types on the catch, Dr. Miller felt it was more important to eliminate boat and captain influences in the catch. The primary goal was to have an unbiased characterization of the sites studied.

Mr. Thompson asked what Dr. Miller felt was the primary loss in information by conducting the study with standardized gear types. Dr. Miller stated the results would not indicate optimum catch rates. Mr. Young requested that Dr. Miller include this analysis into his final report for the charterboat angling study.

Mr. Carter asked Dr. Miller whether a final report would be written to summarize the angling study. Dr. Miller replied he was in the process of completing final edits to the report and would then submit it to MES. Once the report is finalized and released by Maryland Port Administration, MES will distribute copies to the captains involved in the study and to other interested parties.

Note: Due to the stimulated discussion concerning the 53"striped bass captured in Blackstone, MES investigated the raw data sheets and found that an error in data entry occurred. The maximum size striped bass captured in Blackstone was 33 inches.

Additional Comments:
Mr. Thompson and Mr. Carlyle Brown recalled that years ago (early to mid-sixties) during the period of placement activity in the area just above the Bay bridge deemed 'the old dumping grounds', hardly a fish could be found in the upper Bay. It appeared that there was some sort of red worm inhabiting the areas and hatching in such abundance that the striped bass were fixated on them. Mr. Gill added the same area, now known as Site 104, seems to be an area for catching the hatchery released Atlantic Sturgeon.

Finally, there was concern, stemming from comments receive via Laurence "Bud" Thomas, that dredging or placement had occurred in an area North of Pooles Island. The charterboat captains were concerned this activity was a result of lack of time for the contracted dredging companies to make it to the designated placement areas. MES commented that Philadelphia Army Corps of Engineer inspectors

monitored the dredging and placement activity and that contractors were required to report latitude and longitude from each placement action.

APPENDIX B

WATERFOWL, RAPTORS, FINFISH AND SHELLFISH

LIFE HISTORIES, TROPHIC INFLUENCES AND HABITAT REQUIREMENTS

APPENDIX B - WATERFOWL, RAPTORS, FINFISH AND SHELLFISH LIFE HISTORIES, TROPHIC INFLUENCES AND HABITAT REQUIREMENTS

WATERFOWL LIFE HISTORIES, TROPHIC INFLUENCES AND HABITAT REQUIREMENTS

RAPTORS LIFE HISTORIES, TROPHIC INFLUENCES AND HABITAT REQUIREMENTS

FINFISH LIFE HISTORIES, TROPHIC INFLUENCES AND HABITAT REQUIREMENTS

FINFISH LIFE HISTORIES, TROPHIC INFLUENCES AND HABITAT REQUIREMENTS (cont.)

SHELLFISH LIFE HISTORIES, TROPHIC INFLUENCES AND HABITAT REQUIREMENTS

WATERFOWL LIFE HISTORIES, TROPHIC INFLUENCES AND HABITAT REQUIREMENTS

AMERICAN BLACK DUCK - (*Anas rubripes*)

American Black Ducks have always been a visible component of the avifauna on the Chesapeake Bay. Migration into the Bay begins in late September and peaks during October and November. Courtship activities begin as early as September, and by December most pair bonds are formed. Nesting occurs throughout the Bay area with the greatest densities thought to occur on the Eastern Shore from the Chester River south to the Crisfield area. Because of the Black Duck's aversion to human disturbance, most Black Ducks in the Bay now nest on uninhabited islands or remote marshland and adjacent uplands (Krementz, 1991). Black Ducks utilize a wide range of habitats throughout the Bay region; their diversified diet is an excellent representation of this point.

CANADA GOOSE - (*Branta canadensis*)

The Canada Goose departs its breeding grounds in the early fall and uses the Chesapeake Bay as a major wintering area along the east coast. They migrate to the Bay between October and December with peak arrival occurring in November (Doug Forcell, personal communication, Nov.13, 1996). Canada Geese stage and migrate in open water, feed in waters less than 30 feet, preferring 14 feet and less, and winter in open waters. In the Bay, the Canada Goose feeds in Shallow water on a variety of aquatic vegetation and roots, as well as grass, fish, worms, mollusks and crustaceans. In addition, the Canada Goose feeds heavily on waste farm grains on the Eastern Shore and Pennsylvania (Greeley-Polhemus, 1993).

CANVASBACK - (*Aythya valisineria*)

The Canvasback is a winter resident of the Chesapeake Bay and arrives in early to mid-December. The Canvasback is a pochard, and like other pochards, is unable to walk on land and thus its habits and foods are tied to the aquatic environment of the Bay (Greeley-Polhemus, 1993). The Canvasback historically fed primarily on submerged aquatic vegetation and shellfish. The diet of the Canvasback shifted dramatically in the 1960s and 1970s due to declines in submerged aquatic vegetation beds throughout the Bay, particularly in the once rich aquatic beds of the Susquehanna Flats. Canvasbacks are omnivorous and, in response to the loss of SAV, have switched diets from plants to mostly animal foods. The diet of Canvasbacks in the Chesapeake is primarily (97%) Baltic clams (Haramis, 1991). Courtship rituals begin in the Bay in the early spring and shortly thereafter, spring migration occurs.

GREATER AND LESSER SCAUP - (*Aythya marila* and *Aythya affinis*, respectively)

Scaup breed in Canada and the northern United States and in the fall migrate south to overwintering grounds in the Chesapeake Bay. Scaup populations in the Bay consist of two species, the Greater Scaup and the Lesser Scaup. The Greater Scaup is predominantly a maritime species and northern breeder and may utilize different migration routes than the Lesser Scaup. The Lesser Scaup breeds farther South and has a tendency to congregate on islands (Kortight, 1942). The Scaup is considered a diving duck and thus their diet consists of mollusks and other aquatic invertebrates as well as small amounts of aquatic vegetation (Ehrlich *et al.*, 1988). Scaup winter primarily on open water and may spend an entire winter without coming ashore. However, they may rest on flats, mudbars, or even ice (Mulholland, 1985).

MALLARD - (*Anas platyrhynchos*)

The Mallard has traditionally been mainly a Mississippi Flyway duck, but populations tend to spill over to other flyways (Perry, 1987). Mallards are abundant migrant and winter residents in the Chesapeake Bay. They are most abundant in shallow fresh or brackish water near agricultural fields, particularly in upper tributaries of the Bay. The Mallard feeds largely on submerged aquatic vegetation and terrestrial vegetation with animals accounting for less than 5% of the total food volume (PCOE, 1984). In addition, Mallards feed heavily on grains in agricultural fields and they will utilize a wide variety of habitats. The Mallard is also known to be remarkably tolerant of human activity. Mallards stage, migrate, feed, winter and breed in the Chesapeake Bay in shallow water.

RED-BREASTED MERGANSER - (*Mergus serrator*)

Fall migration to the Bay occurs between mid-October and mid-December with peaks between November 1 and November 30 (Stewart, 1962). The Red- Breasted Merganser is a diving duck that feeds primarily on fish and macro-invertebrates. Mergansers stage, migrate, feed and winter in shallow to deep water and they breed on land within 50 feet of water. Normal spring migration out of the Bay occurs between March and May with peak emigration occurring between March 25 and April 25 (Stewart and Robins, 1958).

TUNDRA SWAN - (*Cygnus columbianus*)

The Tundra Swan breeds on Arctic islands and ponds north of the Arctic Circle in the summertime. Large populations winter in the Chesapeake Bay and the area has historically been the most important wintering area for Tundra Swans in North America (Perry, 1987). While wintering in the Bay, the Tundra Swan is generally restricted to fairly extensive open estuarine waters not more than 5 feet deep (Greeley-Polhemus, 1993). The Tundra Swan feeds by extending its head underwater and sieving for aquatic plants, frogs, small fish, shellfish, and macroinvertebrates. Tundra Swans are usually found in the lower Bay, near the Eastern Shore and they leave the Bay after the first spring thaw and head northward (Bellrose, 1978).

WOOD DUCK - (*Aix sponsa*)

The Wood Duck is the most abundant of the breeding waterfowl in the Bay region with scattered pairs occurring throughout wetlands associated with deciduous forests. They use a wide variety of habitats and utilize small creeks and pools in upland forests, as well as riparian corridors, marshes in tidal-fresh and brackish reaches of estuaries (Haramis, 1991). Wood Ducks are year-round residents of the Bay region. They are early migrants and begin their migration south in late September and early October. Cooler temperatures in late October and early November push Wood Ducks further south for the winter months. Wood Ducks stage, migrate, feed and winter in less than six feet of water. They eat nuts, mast from nut and mast producing trees, insects and commercial grains (Greeley-Polhemus, 1993).

COLONIAL WADING BIRDS - (Great blue heron - *Ardea herodias*, egrets - *Casmerodius* spp., Little blue heron - *Egretta caerulea*, Green-backed heron - *Butorides striatus*, Black-crowned night heron - *Nycticorax nycticorax*)

This group of birds includes the herons and egrets. There are six species of herons and egrets common in the Bay. These six species are the Great Blue Heron, Great Egret, Snowy Egret, Little Blue Heron, Green-Backed Heron and Black-Crowned Night Heron. Colonial wading birds are top carnivores and all six species are known to nest together or in close proximity. The southern tip of Pooles Island is known to contain a Great Blue Heron rookery consisting of approximately 2400 nest sites (Jim Potty, personal communication, Nov.14, 1996). Although populations may not currently be declining, factors of concern are continued degradation of water quality needed to support SAV beds, loss of wetlands and disturbance of islands and colonial nesting sites by hum.. activity (Erwin and Spendelow, 1991). Individuals of two species, the Great Blue Heron and Black-Crowned Night Heron are year-round residents of the Bay. Otherwise, nesting colonies form after the arrival of the birds in late winter or early spring.

RAPTORS LIFE HISTORIES, TROPHIC INFLUENCES AND HABITAT REQUIREMENTS

OSPREY - (*Pandion haliaetus*)

Osprey are the only North American hawk that feed almost exclusively on live fish. They are known for their tolerance of human activity and their adaptability to artificial nest structures in close proximity to waterfront areas. The Osprey is a highly visible, easily observed creature whose position at the top of the food chain makes it a valuable indicator species for detecting changes in the environment (Reese, 1991). This fact was evident from the 1950's through the early 1970's when organochlorine pesticides (DDT) adversely affected reproductive success and led to a serious population decline. The banning of some major pesticides in the early 1970's, including DDT, has allowed Osprey reproductive rates to rebound dramatically, enabling the Osprey population to grow steadily during the 1980's.

Osprey winter in the tropics and nest in temperate to sub-arctic latitudes(Reese, 1991). Osprey are distributed throughout the tidal Chesapeake Bay and nesting is common along wide, shallow portions of tributaries. Pooles Island currently supports approximately 10 nest sites which are located on or directly around the island (Jim Potty, personal communication, Nov. 14, 1996). The Osprey's diet consists almost entirely of medium sized fish which are caught just beneath the surface. Osprey arrive in the Bay region in late February and early March with courtship and nest building proceeding shortly thereafter. Egg laying and incubation takes place between mid April and late May followed by the period of late May through June which is the most intensive rearing period for the young. Fall migration occurs as soon as fledglings become independent and are able to make the flight south to Central and South America. This usually occurs by September.

BALD EAGLES - (*Haliaeetus leucocephalus*)

The Chesapeake Bay provides extremely important habitat for the endangered Bald Eagle (*Haliaeetus leucocephalus*). This rich estuary may compose the most important Bald Eagle habitat in eastern North America. Not only do almost 200 pairs of Chesapeake eagles produce about 200 young each year, the Bay also provides winter and summer habitat for an unknown number of eagles from East Coast populations from Maine to Florida (Buehler, 1990). The Bald Eagle is a predator and carnivore which feeds on fish and a variety of different species. The Bald Eagle's position at the top of the food web makes it an excellent indicator of the overall health of our estuarine ecosystem. The Chesapeake Bay habitat may have held as many as three thousand breeding pairs at one time, however, the use of pesticides (DDT), as well as habitat destruction caused Bald Eagle numbers to drop below 100 pairs by 1970. The banning of DDT and other pesticides in the early 1970's has helped the Bald Eagle population to rebound, however, the future of this species is by no means assured.

The Chesapeake Bay provides a year round habitat for locally reared eagles. In addition, the Bay provides key habitat for migrating eagles along the Atlantic Coast. Egg laying for Bald Eagles occurs typically between January and March with a peak in February (Fraser *et al.*, 1991). The young are ready to leave the nest between May and July. They rely on their parents for a number of weeks after their first flights, but they gradually learn to hunt and spend more time on their own and by the winter they are entirely independent.

Requirements for Bald Eagle nesting include mature forested shoreline and a low level of human development. Bald Eagle concentration areas include the Aberdeen Proving Ground in Hartford County. For the past six years Pooles Island has supported a single Bald Eagle nest which produces young. In 1996 two Bald Eagle young were successfully reared on the island (Jim Potty, personal communication, Nov.14, 1996). Bald Eagles are opportunistic predator scavengers taking many species of fish, birds, and mammals. They prefer fish taken alive or dead, but turn to waterfowl, white- tailed deer, and other species during periods when fish are scarce (Fraser *et al.*, 1991).

FINFISH LIFE HISTORIES, TROPHIC INFLUENCES AND HABITAT REQUIREMENTS

ALEWIFE AND BLUEBACK HERRING (*Alosa pseudoharengus* and *Alosa aestivalis*)

The majority of the information concerning the habitat requirements and life stages of alewife and blueback herring are taken from Kauda (1991).

Alewife and blueback herring are anadromous spawners which school in large numbers relatively close to shore. They may return to natal streams to spawn. They were once commercially important, but stocks began to decline dramatically in the early 1970's.

RANGE

Alewives are distributed from Newfoundland to North Carolina. Alewives are abundant in mid-Atlantic and northeastern states. In the mid-Atlantic region, alewives occur in virtually all tributaries to the Chesapeake Bay.

Blueback Herring are distributed from Nova Scotia to Florida. They are most numerous in warmer waters from the Chesapeake Bay south. They occur in the Chesapeake Bay and virtually all of its tributaries.

LIFE HISTORY

Alewives spawn in the spring. Spawning is dependent on water temperature. In the Chesapeake Bay, the onset of spawning migration is typically mid-March through April. Males tend to precede females upstream to the spawning grounds. Alewives tend to favor slow-moving sections of streams or coastal ponds and lakes for spawning sites. They reportedly spawn in a wide range of substrates, from coarse gravel to organic detritus.

Eggs hatch according to water temperature, usually in 3-6 days. Larvae begin feeding at 3-5 days' post-hatch. Larvae school within two weeks of hatching. Larvae are positively phototropic and alternate between active vertical movement toward the surface and passive vertical descent. Feeding alewife larvae transform gradually to the juvenile at about 20 mm. Juvenile alewives tend to remain in the tidal freshwater nursery areas in spring and early summer, but may move upstream in summer with the encroachment of saline water. Juveniles move downstream in the fall with declining water temperatures. Some juvenile alewives remain in estuarine water through the winter.

Alewife spawning stocks contain primarily ages III-VIII, with the modal group generally ages IV or V.

Blueback herring spawn somewhat later than alewife, generally from mid-April to late May in Chesapeake Bay tributaries. Spawning behavior is very similar to alewife. Egg and larval development are very similar to alewife. Juvenile blueback tend to remain in natal rivers about a month longer than alewife before returning to the sea.

TROPHIC INFLUENCES

Alewife larvae of about 6 mm feed on small cladocerans and copepods, adding larger species to their diets as they grow. Larvae appear to be highly selective feeders. Juveniles have been observed to feed on dipteran midges, cladocerans, ostracods, insect eggs and insect parts. Alewife juveniles, blueback herring and American shad juveniles coexist in the nursery areas in the summer and fall, so interspecies competition is possible.

All life stages of the alewife are important to predators. Freshwater and marine fishes, birds, amphibians, reptiles and mammals all feed on alewife.

HABITAT REQUIREMENTS

Alewife -

Temperature:	egg - 11-28 °C, prolarva 8-31 °C, postlarva 14-28 °C, early juvenile 10-28 °C
DO:	egg to postlarva >5.0 mg/l
Salinity:	egg: 0-2 ppt, prolarva 0-3 ppt, postlarva and early juvenile 0-5 ppt
pH:	egg: 5-8.5 units, prolarva 5.5-8.5 units
Suspended Solids:	egg - <1000 mg/l

Blueback Herring-

Temperature:	egg and prolarva 14-26 °C, postlarva 14-28 °C, early juvenile 10-30 °C
DO:	>5.0 mg/l pro and postlarva, >4.0 mg/l early juvenile
Salinity:	egg, pro- and postlarvae 0-22 ppt, early juvenile 0-28 ppt
pH:	egg: 5.7-8.5, prolarva 6.2-8.5
Suspended Solids:	egg <1000 mg/l, prolarva < 500 mg/l

AMERICAN SHAD AND HICKORY SHAD (*Alosa sapidossima* and *Alosa mediocris*)

The majority of the information concerning the habitat requirements and life stages of American and hickory shad are taken from Klauda (1991).

American and hickory shad are large, anadromous fish that have exhibited drastically declining populations in the latter half of the 20th century. A fishing moratorium has been in effect in the Maryland portion of the Chesapeake bay since 1980. Previous to this, American shad had supported recreational and commercial fisheries. Hickory shad are described here also. Hickory shad have had a naturally lower abundance and are somewhat smaller than American shad.

RANGE

The American shad is native to the Atlantic seaboard of North America. It is distributed from southeastern Labrador to the St. Johns River, Florida. Along the East Coast, shad are most abundant from Connecticut to North Carolina. The presence of spawning populations in the Chesapeake Bay has been difficult to document in recent years.

LIFE HISTORY

The American shad is anadromous and only enters freshwater in the spring to spawn. It is a schooling species and is highly migratory. Each major shad-producing river is apparently home to a discrete spawning stock. American shad enter coastal rivers in the spring when water temperatures reach 16-19 °C. Males generally precede females to a freshwater area dominated by extensive flats, over sandy or rocky shallows. American shad are broadcast, open water spawners.

Fertilized eggs are pelagic until water-hardened when they are carried along the bottom and may lodge in substrate rubble. Larvae generally hatch in 3-9 days and begin to feed at 4-7 days old. Larvae are photopositive, and are most abundant at the surface. They are found in fresh and brackish water up to 7 ppt and generally drift downstream. Mortality of larvae is high. Juveniles metamorphose at 21-28 days, when the young shad reach 25-28 mm. They form schools at 20-30 mm. Juveniles prefer deep pools away from the shoreline in non-tidal areas. Juveniles spend their first summer in the Chesapeake Bay in the tidal freshwaters of the spawning rivers.

Juvenile American shad leave the nursery areas in late fall and join other schools of young shad in the ocean. Chesapeake Bay stocks remain at sea for four to five years.

The Hickory shad life history is less well documented than the American shad. It is also known to be an anadromous spawner and to generally follow the stages of the American shad.

TROPHIC INFLUENCES

Young American shad feed on plankton, with size selection of copepods, other crustaceans, zooplankters, chironomid larvae and terrestrial insects being important food items. Juveniles also occasionally consume small fish species such as bay anchovies and mosquitofish. In the bay, juvenile shad coexist with other juvenile fish and may compete for resources.

HABITAT REQUIREMENTS

Temperature: eggs 13-26 °C; larvae - 15.5-26.5 °C; juveniles - 15.6-23.9 °C
Salinity: wide tolerance
DO: eggs - 4.0 mg/l, juveniles and adults - 5.0 mg/l
Suspended solids: < 1000 mg/l for eggs, < 100 mg/l for larvae, juveniles and adults;
Physical habitat: no special requirements - eggs can not be covered by silt or sand.

ATLANTIC MENHADEN (*Brevoortia tyrannus*)

The majority of the information concerning the habitat requirements and life stages of Atlantic menhaden are taken from Lippson (1991).

The Atlantic menhaden is an oceanic species of fish whose populations in the Bay have remained stable in recent years. Menhaden are not a food fish, but are important for industrial uses, where they are processed for fish oil and meal for livestock feed. Watermen also use menhaden as bait for crabs and recreational fishermen grind them into chum. Commercial fishermen harvest enormous quantities of menhaden. Approximately 2 billion pounds were harvested in 1989, making menhaden the second most important fishery species in the US.

RANGE

Menhaden are indigenous to the coastal waters and estuaries of the eastern US and Canada and they range from Nova Scotia to central Florida. They are catadromous spawners, who develop in less saline water and return to the ocean to spawn. Menhaden are sexually mature at about two years. The Chesapeake Bay is an important nursery ground for menhaden. They occupy almost the entire Bay and its tributaries.

LIFE HISTORY

Larval menhaden are pelagic and spend about 1 month in the waters of the continental shelf before they enter the Bay. When they enter the Bay in the early summer they are about 8 mm (0.03 in) in size. In the bay, they move to the lower salinities in estuarine tributaries. At about 34 mm (0.12 in), they metamorphose to juveniles. Juvenile menhaden remain in the Bay until the fall when most migrate to the ocean. They overwinter offshore of Cape Hatteras. Menhaden spawn in inshore waters, bays and in waters over the coastal continental shelf north of Long Island Sound.

As larvae, menhaden feed on zooplankton, mainly pteropods, the larval stages of bivalves and crustacean nauplii. Pre-juveniles (30 mm) develop an enhanced ability to graze on phytoplankton and suspended detritus. Later stage adults and juveniles are primarily herbivores.

TROPHIC INFLUENCES

Menhaden are an important part of the food chain. They school in large numbers and as adults can filter the plankton from 3.9 gallons (0.015 m^3) of water a minute. This equals a filtering capacity of 1 million gallons (3800 m^3) of water in 180 days per fish. This results in the consumption and redistribution of significant amounts of energy and material in the bay.

Menhaden are fed upon by many predatory fish species. The large schools attract voracious feeders such as striped bass, bluefish, Spanish mackerel, tuna and sandbar sharks. In addition, herons, egrets, ospreys and eagles also prey on them.

HABITAT REQUIREMENTS

Lippson (1991) lists habitat requirements for menhaden as:
Temperature: less than 33 °C
Salinity: greater than 3.5 ppt
DO: greater than 1.1 mg/l, with no special structural habitats.

BAY ANCHOVY (*Anchoa mitchilli*)

The following information concerning the history and habitat requirements of the Bay anchovy are taken from the Houde and Zastrow (1991) summary concerning this species in the *Habitat Requirements for Chesapeake Bay Living Resources*.

RANGE

Bay anchovies occur along the Atlantic Coast from Maine to the Yucatan Peninsula, including the Florida Keys. The bay anchovy is the most abundant fish in the Chesapeake Bay and occurs throughout its waters. Two *Anchoa* species occur in the Bay and the mid-Atlantic region: *A. mitchilli* and *A. hepsetus*. Adult bay anchovies migrate during winter to deeper waters in the Bay. Larvae and small juveniles are distributed throughout the Bay; some migrate or are transported into low salinity sub-estuaries, remaining there until fall before dispersing to over-wintering areas. Figure 4-6 presents the habitat distribution of spawning and nursery areas and adults in the upper Chesapeake Bay for the bay anchovy.

LIFE HISTORY

Spawning is widespread in the Chesapeake Bay and occurs from May to September, with peak spawning in July. Bay anchovies are batch spawners with individual females spawning at least 50 times each season. Peak spawning in the bay occurs at 13-15 ppt and at average surface water temperatures from 26.3-27.8°C. Age I females produced from 92 to >99% of the eggs spawned in July of 1986 and 1987 in mid-Bay. Thus, a reproductive failure in one year could drastically reduce further numbers of age I females and have a major impact on egg production for a season.

Bay anchovy eggs have been collected in most areas of the Bay and its tributaries. Fertilized bay anchovy eggs are pelagic and slightly ellipsoid. Larval bay anchovy are 1.8-2.0 mm at hatch. Bay anchovies live to approximately three years of age and seldom grow longer than 90 mm.

TROPHIC INFLUENCES

The bay anchovy plays a key role in the Chesapeake Bay food web. It is a major consumer of zooplankton and a dominant prey item in diets of commercially and recreationally important predatory fish including striped bass, weakfish, bluefish, and summer flounder. Bay anchovies provide more than half of the total energy intake of predatory fish in the Bay, contributing 70, 90, and 60% to their diets in summer, fall, and spring, respectively.

HABITAT REQUIREMENTS

Bay Anchovy-

Temperature: Broad Range of 13-30 °C
Salinity: A maximum of 80 ppt, usually 0-30 ppt
Physical: Adult are collected from waters as deep as 27-36m although it generally occurs in shallower depths. Schools tend to be located nearer to surface than bottom, but changes in depth distribution occur, seasonally and diurnally. The bay anchovy had been collected over many substrates, including sand, mud, sea grass, oyster shell and hard bottoms.

CHANNEL CATFISH, BROWN BULLHEAD AND WHITE CATFISH (*Ictalurus nebulosus, Ictalurus* punctatus and *Ictalurus catus*)

Catfishes are recognized by their characteristic "whiskers" or barbels. They are found in almost all fresh and brackish waters of Maryland.

RANGE

The channel catfish ranges from Florida north to New York and can also be found in New Mexico and Colorado (Stagg, 1986). In the Chesapeake Bay, these fish are restricted to two areas, the upper Bay/Susquehanna River and the Potomac River. They have been stocked in many other tributaries but populations have not become established (Lippson, 1985). White catfish can be found from Florida north to New York and along the Gulf Coast. In the Chesapeake Bay, they can be found in the tidal tributaries as far north as the Patapsco River. The brown bullhead dwells in southern Canada, eastern US, and the Gulf states. They are widespread and can be found in the tidal tributaries of Maryland and Virginia.

LIFE HISTORY

Channel catfish spawn in the tidal freshwater of the Chesapeake Bay in mid-spring (before May). Large heavy eggs are laid in adhesive clumps, usually in nests built by a parent. After leaving the nest, juvenile catfish congregate in dense schools for a period of time (Lippson, 1985). White catfish and brown bullhead spawn during May and June in tidal freshwater. Adhesive eggs lay in large nests. Early juveniles are herded about in large schools (Seltzer-Hamilton, 1987).

TROPHIC INFLUENCES

Channel catfish are omnivorous/piscivorous and feed on a large variety of plants and animals (including fish) near the bottom (Brandt, 1994). In a study by Weisburg in 1985, chironomid larvae were the most abundant prey in the catfish diet and most frequently consumed. The *Cheumatopsyche* larvae, cladocerans and chironomids are also important components. Additionally, aquatic insects, bottom arthropods, herring, bluegills, small catfish, elm seeds, gizzard shad and crayfish are included in their diet. White catfish feed on pondweeds, aquatic insects, fish (alewives, shad, etc.) and fish eggs. Brown bullhead feed on insects, fish, fish eggs, mollusks and plants (Brandt, 1994).

HABITAT REQUIREMENTS

Channel Catfish -

Temperature: >21.1 °C
Salinity: A maximum of 19-21 ppt, usually <1.7 ppt
Physical: Deep channels of large rivers in sluggish to swiftly flowing current. Commonly captured at depths of <21.3 meters. Also in lakes, ponds, bayous and stagnant pools. Clear to muddy in water over sand, gravel or rubble.

White Catfish -

Temperature: A maximum of 29.2-31 °C
Salinity: A maximum of 14.5 ppt
Physical: Adults stay in channels and streams with a sluggish current. Also in lakes, ponds and bayous. They also stay in fresh to slightly brackish water with an intermediate current. Go progressively deeper from April to October then back up after fall turnover.

Brown Bullhead -

Temperature: A maximum of 28.9-37.5 °C
Salinity: A maximum of 10 ppt
Physical: Usually found in deeper canals over mud among aquatic vegetation. They are nocturnal and are also found in reservoirs, swamps, ponds and stagnant water. Tend to burrow in soft sediments.

SPOT (*Leistomas xanthuras*)

The majority of the information concerning the habitat requirements and life stages of Spot are taken from Homer and Mihursky (1991).

Spot do not support a major commercial or recreational fishery in the Chesapeake Bay. However, the abundance and important ecological functions of spot in the Bay make it a significant member of the Chesapeake Bay community. Spot play a key role in the trophic dynamics through their benthic invertebrate feeding habits and their role as prey to other species.

RANGE

Spot range from the Massachusetts Bay south along the Atlantic Ocean to Florida and into the Gulf of Mexico. The species is found in a variety of habitats, from marine to brackish waters and in water depths ranging from 1 to 130 meters. Spot have been found in all parts of the mainstem of the Chesapeake Bay and in all tributaries. They occur primarily in brackish to high salinity areas, although they have been found in fresh water. They occur in most types of bottom substrates.

LIFE HISTORY

Spot spawn from late September through March. They are found in the Chesapeake Bay from April or May through the late fall. They migrate to the sea with decreasing water temperatures. Spawning occurs in moderately deep areas along the western Atlantic continental shelf from North Carolina to northern Florida. Larval spot enter the Bay as early as April and rapidly reach the juvenile stage. As the summer progresses, young spot move further up the mainstem of the Bay and into the tributaries. Juvenile spot are obligate bottom feeders, adapted to scoop and strain organisms from the sediment. They feed indiscriminately on benthic organisms, primarily copepods, polychaetes and small mollusks. They show a preference for feeding over muddy substrates.

TROPHIC INFLUENCE

The feeding habits of spot are thought to significantly affect the density of benthic invertebrates in the Bay in the summer. There is a sharp decline in benthic invertebrate populations that coincides with the periods of juvenile spot growth and abundance in the summer. It has also been estimated that spot turn over the top 2 cm of sediment in their feeding areas every 120 days. Natural predators of adult spot are striped bass, silky shark, weakfish and bluefish. Spot larvae are eaten by silversides, striped killifish and chaetognaths. Spot juveniles are eaten by weakfish, bluefish, striped bass, white perch, Atlantic croaker, silver perch, summer flounder, American eel, brown bullhead, white and channel catfish and oyster toadfish.

Because of their feeding habits, spot have a higher degree of exposure to potential contaminants in sediments than most finfish. They will also be affected by elevated levels of contaminants in their prey, which live in sediments.

HABITAT REQUIREMENTS

Temperature: 6-25 °C
Salinity: 0-60 ppt
DO: >2.0 mg/l preferred
Suspended and deposited sediments: <100 mg/l est.
Structural habitats: mud, mud/sand bottom, prefers 6-10 m depth zone. Deep holes used by juveniles in winter.

STRIPED BASS (*Morone saxatilis*)

The majority of the information concerning the habitat requirements and life stages of striped bass is taken from Seltzer-Hamilton and Hall (1991).

The striped bass is a preferred commercial and recreational anadromous finfish that originates in the Chesapeake Bay and spends much of its first two years in the Bay. The species has undergone a decline since the 1970's, first as a result of overfishing and more recently from poor water quality. There is increasing concern that reduced dissolved oxygen in deeper waters of the upper bay has eliminated summer habitat for adult and subadult striped bass.

RANGE

Striped bass range from the St. Lawrence river in Canada to the St. Johns River on Florida's east coast, and from the Suwannee River in western Florida's east cost to Lake Pontchartrain, Louisiana. The principal spawning and nursery areas of striped bass are along the Chesapeake Bay and its tributaries.

Striped bass have a complex migratory pattern based on seasons, natal river locations and age, sex and degree of maturity of fish. Generally, after age II, most females and some males leave their natal estuary and make seasonal coastal migrations. Adults generally move northward up the east coast in spring, spend the summer in northern coastal Atlantic waters from New York to Canada, and migrate south in the fall to waters from coastal New Jersey to North Carolina. Large numbers of striped bass overwinter in deeper waters of the Chesapeake Bay and its tributaries.

LIFE HISTORY

Striped bass spawn in the Chesapeake Bay from early to mid-April through the end of May, primarily in tidal freshwaters. Spawning activity is apparently triggered by a rise in water temperature. Striped bass eggs hatch within 80 hours of fertilization. Females weighing more than 10 lbs produce eggs with a much greater probability of hatching than do smaller females. Striped bass larvae begin feeding about five days after hatching, at about 5 mm. As striped bass larvae grow, they are found in progressively deeper water. Striped bass larvae begin to metamorphose to juveniles at about 20 mm. As larvae develop, they move inshore and spend the summer and early fall in shoal waters less than 2 meters deep. Shallow-water, near shore areas seem to be preferred habitats of juvenile striped bass.

In the Chesapeake Bay, most fish are sexually mature by age II or III. Typically only sexually mature fish participate in spawning migrations.

TROPHIC INFLUENCES

Striped bass larvae feed primarily on copepodite and adult stages of copepods and cladocerans. Juvenile striped bass are non-selective and flexible in their feeding habits. They consume insect larvae, polychaetes, larval fish, mysids and amphipods. Fish become an increasingly more important part of the diet of juvenile and adult striped bass. By age II, striped bass feed primarily on fish.

HABITAT REQUIREMENTS

DO:	>5.0 mg/l
Salinity:	0-15 ppt
TSS & Turbidity:	egg <1000 mg/l, prolarva < 100 mg/l, postlarva <<500 mg/l, juvenile 0-10 mg/l clay/silt, 0-2000 mg/l fine sediments
pH:	egg - 7-9.5 units, pro and postlarva 7-8.5 units
Temperature:	egg 12-23 °C, prolarva 18-23 °C, postlarva 12-23 °C, juveniles 10-20 °C
Light:	Important in first 25 days post-hatch
Hardness & Alk:	>150 mg/l
Depth:	Overwinter in depths >9 m
Substrate:	Velocity and flow of freshwater may be related to successful spawning.

WHITE PERCH (*Morone americana*)

The majority of the information concerning the habitat requirements and life stages of white perch are taken from Seltzer-Hamilton (1991).

White perch is one of the most abundant fish in the Chesapeake Bay. It supports important commercial and recreational fisheries, ranking in the top five commercial catches, with recreational catches sometimes exceeding commercial. White perch are semi-anadromous and spend their entire lives in the Bay. White perch are sensitive to water quality, in particular they require a higher dissolved oxygen level than some other fish in the Bay.

RANGE

White perch are endemic in Atlantic coastal waters from Nova Scotia to South Carolina. They are euryhaline, with the largest numbers found in brackish water.

LIFE HISTORY

White perch migrate from lower estuaries to freshwater to spawn and are thus semi-anadromous. In the Chesapeake Bay, adult white perch overwinter in the downstream portion of tributaries and the deeper saline waters of the mainstem, and migrate up to tidal fresh and slightly brackish tributaries in the spring to spawn. Spawning migrations begin by the latter half of March, with ripe adults on the spawning grounds by the beginning of April. Peak spawning activity occurs in April and May, according to optimal water temperatures. Spawning occurs in fresh and tidal freshwater to a salinity of about 4.2 ppt.

Most spawning occurs over fine gravel or sand, generally in depths of 1-6 m in estuaries. Newly hatched larva average 2.6 mm and are prolarva (non-feeding) for 4-13 days. Rotifers and copepod nauplii are the dominant prey of 3-4 mm white perch larvae. Copepodites and *Bosmina* are the dominant prey of 5-7 mm larvae, and adult copepods and cladocerans are the dominant prey of 8-15 mm larvae. Late larval and early juveniles consume adult copepods.

The primary nursery grounds for white perch are inshore zones of estuaries and creeks, somewhat downstream from the spawning grounds.

TROPHIC INFLUENCES

Larval white perch are zooplankton predators, and in turn are prey for juvenile white perch and other species. Larval white perch feed on rotifers, copepod nauplii, cladocerans and copepodites. Older larvae feed on adult stages of copepods. Juvenile white perch feed on benthic invertebrates and insect larvae. Larger white perch feed on tunicates. Older white perch feed increasingly on other fish.

Juvenile bluegills are predators of larval white perch. White perch larvae coexist with many other potential fish predators in tidal freshwaters. Juvenile white perch in estuarine habitats are prey to yearling and older striped bass, adult white perch and probably bluegills.

HABITAT REQUIREMENTS

Water Temperature: eggs and larvae 12-20 °C, first-feeding larvae 15-20 °C, juveniles and adults, 10-30 °C
Salinity: eggs, larvae - 0-1.5 ppt, juveniles 0-3 ppt, adults 5-18 ppt
DO: >5 mg/l, all stages
Suspended Sediments: eggs < 100 mg/l, larvae, juveniles and adults < <500 mg/l,
Shear: eggs and larvae < 120 dynes/cm-2

Structural Habitat: Deep holes required for overwintering, mud sand or clay bottoms with little or no cover. Shallower depths for larvae. Adults prefer 4.6-9 m depths during the day, < 1 m at night.

WINTER FLOUNDER (*Pseudopleuronectes americanus*)

The majority of the information concerning the habitat requirements and life stages of winter flounder are taken from Lippson (1985).

Winter flounder are common winter residents of Maryland's portion of the Chesapeake Bay. They are cold-water fish and do not tolerate the higher summer temperatures of the Bay waters. Although they are primarily ocean fish, these bottom-dwelling fish are widely distributed throughout the Bay and into lower-salinity waters.

RANGE

Winter flounder range from Georgia north to Labrador, Canada (Robins, 1986). In the Chesapeake Bay, winter flounder are found at least to the Sassafras River. The greatest area of concentration tends to be the open Bay between Kent Island and Hoopers Island.

LIFE HISTORY

Winter flounder enter the Chesapeake Bay to feed and spawn during the winter months and migrate back to sea during the summer months. This seasonal pattern contrasts with that of many other migrant fish species that enter the Bay in the spring or early summer and leave with the onset of winter. Winter flounder, from November to May, can be found in deep channel waters except when spawning, in which case they move to shallower water.

Spawning occurs from mid-February to mid-March, when water temperatures range from 0 - 5.6° C. Eggs sink to the bottom and cling together. There they are undisturbed by currents. Juveniles remain in the Bay and its lower tributaries in shallow, inshore waters during their first summer.

TROPHIC INFLUENCES

Winter flounder feed on polychaetes, small crustacea, small bivalves, and bivalve siphons (Levinton, 1982).

HABITAT REQUIREMENTS

Temperature:	egg 1-10°C, peak 2-5°C, larvae, juvenile 0-25°C, normal growth 12-16°C.
Salinity:	egg 11.4-33 ppt, larvae 3.5-27.7 ppt, peak abundance 6-15 ppt, juvenile 4-30 ppt, normal growth at 20 but not 30 ppt.
Habitat:	Eggs are demersal, larvae are pelagic and strongly bottom oriented before metamorphosis. Juveniles are benthic and remain in estuaries for two or more years. Winter flounder will remain in shore except for temperature extremes.

YELLOW PERCH (*Perca flavescens*)

The majority of the information concerning the habitat requirements and life stages of yellow perch are taken from Piavis (1991).

Yellow perch have been an important fish species in the Chesapeake Bay because their early spawning run has provided the earliest catch opportunity for recreational and commercial watermen. Stocks of yellow perch have been in decline since the 1960's. Contributing factors are thought to include sedimentation, decreased spawning habitat and interaction with metals and acid rain. Eutrophication and resultant decreased dissolved oxygen also reduce the forage base for yellow perch.

RANGE

Yellow perch range from South Carolina north to Nova Scotia, west through the southern Hudson Bay region and Saskatchewan and south to the northern half of the Mississippi River drainage. Yellow perch have been reported in all tributaries of the Chesapeake Bay. Yellow perch are more prevalent in the upper Bay. All upper Bay tributaries have been found to hold yellow perch. The Bush, Sassafras, Northeast, Back and Middle Rivers produce the majority of the landings for the fishery in the upper Bay.

LIFE HISTORY

Adult yellow perch migrate to spawning areas in less saline upper reaches of the Bay in mid-February to early March. Spawning takes place in mid-March. Eggs are adhesive and are thought to be deposited in riparian litter and organic debris. Hatching occurs 25-27 days after fertilization. Yellow perch hatch at 5-8 mm. Prolarva remain near cover. Juveniles are 25-42 mm in length. Juveniles migrate from the limnetic to the littoral zone to feed on richer near-shore food sources. Fecundity of adult yellow perch increase with weight. Adult yellow perch remain in natal river systems. The only migration that occurs within the natal waterbody is a downstream migration for juveniles.

TROPHIC INFLUENCES

Copepods and cladoceran are thought to be first foods for yellow perch. Juveniles continue to feed on pelagic plankton, but then switch to benthic invertebrates. Adult yellow perch in the Chesapeake Bay feed on anchovies, killifish, and silversides. Yellow perch are eaten by top predators in the Bay. Predators could include striped bass, largemouth bass, chain pickerel, catfish, white perch and bluefish. Yellow perch may also be fed upon by ospreys, bald eagles, gulls, terns, herons and egrets.

HABITAT REQUIREMENTS

Temperature:	egg - 7-2 °C, larvae, juvenile, 10-30 °C, adult 6-30 °C
Salinity:	egg, larva 0-2 ppt, juvenile 0-5 ppt, adult 0-13 ppt
pH:	6-8.5 all stages
DO:	>5.0 mg/l
TSS:	egg <1000 mg/l, larvae <500 mg/l, juveniles prefer >20 % cover, currents must be less than 2.5 cm/sec for fry, adults prefer >5 cm/s.

SHELLFISH LIFE HISTORIES, TROPHIC INFLUENCES AND HABITAT REQUIREMENTS

BLUE CRAB (*Callinectes sapidus*)

The majority of the information concerning the habitat requirements and life stages of blue crabs are taken from Van Heukelem (1991).

The Blue Crab is ubiquitous in the Chesapeake estuary and utilizes many Bay habitats throughout its lifecycle. At various life stages, they are of great trophic significance as both predator and prey. The abundance of the blue crab makes it important to the ecology of the bay ecosystem and the value of its fishery is of great significance.

RANGE

The blue crab is a free swimming decopod crustacean, whose range was originally from Nova Scotia to Northern Argentina. Blue crab have now been introduced to Europe, the Mediterranean Sea and Japan. In the U.S., blue crab are found in abundance from Texas to New Jersey. In the Chesapeake Bay, blue crab utilize all types of habitats.

LIFE HISTORY

Mature blue crab females migrate to high salinity waters at the mouth of the Bay in summer months. Newly hatched larvae swim to the surface and are carried by surface currents to the waters of the continental shelf. Larval development takes place there, and post-larvae return to the Bay in late summer and fall. Juveniles disperse throughout the Bay and tributaries. Blue crabs reach adulthood in 14-18 months. Crabs overwinter in the Bay, but do not feed or grow in winter months. Crabs are more abundant in shallow water in the summer and in deeper water in the winter.

TROPHIC INFLUENCES

When newly hatched, crabs feed on small rotifers, worm larvae and copepod nauplii. Adult copepods may be the main food of larger zoeae. Blue crabs are scavengers and voracious predators. Blue crabs are likely responsible for controlling populations of some bivalves and fish, and may control their own populations to some extent through cannibalism.

American eels are major predators of blue crabs. Striped bass also consume large numbers of small blue crabs. Other predators are Atlantic croaker, sandbar sharks, cobia, red drum, black drum, oyster toadfish, bull sharks, cownose ray, speckled trout, weakfish, catfish, gars, large mouth bass, loggerhead turtles, Atlantic Ridley turtles, herons, egrets, diving ducks and raccoons.

HABITAT REQUIREMENTS

Temperature, Turbidity, Suspended Solids: No preferences or requirements are known
DO: avoid low dissolved oxygen waters, and are thought to require a DO of >3.0 mg/l.
Salinity: larvae require >20 ppt, adults live in all salinities.

Blue crabs are sensitive to nitrogen concentrations and are limited to waters with <1.0 mg/l ammonia and <0.5 mg/l nitrites. They require a pH of >7.0 units. Grass beds are very important structural habitat requirements for juveniles and molting crabs.

EASTERN OYSTER (*Crassostrea virginica*)

The majority of the information concerning the habitat requirements and life stages of Eastern Oysters are taken from Kennedy (1991).

The eastern oyster adapts well to the fluctuating conditions in the Chesapeake Bay. It can tolerate a wide natural variation in suspended sediments, dissolved, salinity and temperature. It can produce millions of spat in the Bay although high mortality rates in the young stages and overfishing have diminished this fishery.

RANGE

Also known as the American or Virginia oyster, the eastern oyster can be found worldwide. Its range stretches from the Gulf of the St. Lawrence River to the Gulf of Mexico. It is also found in the shallow waters of the Chesapeake Bay.

LIFE HISTORY

Since adult oysters are immobile, they release eggs and sperm into the water for external fertilization. Temperature increases in the Bay stimulates spawning, which may occur from 18 °C to 30 °C. Where temperatures permit, a female may spawn more than once in a season. The eggs develop into ciliated veliger larvae within 24 hours. For about three weeks the larva will be allowed to swim until it finds a suitable substrate upon which to become affixed. Once attached, the gills and digestive tract are elaborated.

TROPHIC INFLUENCES

Larvae exist on suitable plankton before settlement. A young spat requires an adequate quantity of phytoplankton. An adult must also secure proper food to support gametogenesis. The predators of the eastern oyster larvae consist of sea anemones, sea nettles and filter feeding invertebrates. Spat are pursued by flatworms and small crabs. Early oysters are eaten by larger blue crabs and some fish. Adult oysters are consumed by snails and starfish.

HABITAT REQUIREMENTS

Temperature: Subject to -1 °C to 36 °C
Salinity: Spawning requires >7.5 ppt. Adults need >5 ppt for survival and >12 ppt for growth.
Suspended Sediments: Eggs and larvae have 100% mortality when concentrations are 1 g/L. Adults able to withstand erratic increases in turbidity and sedimentation.
pH: Spawn at pH between 7.8 and 8.2. Adults must be in water with pH between 6 and 10 for survival.
Physical: Require firm bottoms like shell, rock or sticky mud.

SOFT-SHELL CLAM AND HARD CLAM (*Mya arenaria* and *Mercenaria mercenaria*)

The majority of the information concerning the habitat requirements and life stages of soft-shell clam are taken from the Baker and Mann (1991).

Soft-shell clams exist in large numbers in relatively shallow, sandy, mesohaline portions of the Chesapeake Bay. They spawn twice a year and grow rapidly, reaching commercial size in two years or less. These clams are also important food for many predators.

Hard clams have been reported to both exist and not exist in the upper Bay. Despite a letter from J. M. Obernesser, Lieutenant Commander, U.S. Coast Guard, stating that hard clams were found in the upper Bay, MES was unable to find, through its literature search, adequate documentation of this assertion. Further, chapter 4 of the 1994 *Basin-Specific Characterizations of Chesapeake Bay Living Resources Status* supports the assertion that the hard clam does not exist in the upper Bay. Also, based on the literature, the salinity in the upper Bay is not high enough to sustain the hard clam.

RANGE

The soft-shell clam is also known as the steamer clam or the mannose. It is found in the water along the Atlantic coast of North America from northern Labrador to Florida, with maximum abundances from Maine to Virginia. In the Chesapeake Bay, soft-shell clams are widely distributed but commercial concentrations occur in areas between the Potomac and Chester Rivers (Lippson, 1985).

LIFE HISTORY

Spawning occurs twice a year in the Chesapeake Bay; once in mid- to late autumn and once in late spring. During spawning both eggs are sperm are released externally. An egg develops into a trochophore larva within a day. After becoming a veliger larva, the larva swims to the bottom and metamorphoses into a juvenile clam. The young clam crawls around and eventually burrows permanently.

TROPHIC INFLUENCES

Soft-shell clams feed on microscopic algae. They consume small flagellated cells and diatoms and can selectively reject non-food particles and toxic dinoflagellates. The presence of soft-shell clams also affects the settlement of many species of infauna. Soft-shell clams can not filter bacteria from the water.

Blue crabs, mud crabs flatworms, mummichogs and spot are major predators of juvenile soft-shell clams. The major predators of adults are blue crabs, eels and cownose rays. Other species that depend on these clams are geese, swans, ducks, raccoons and muskrats.

HABITAT REQUIREMENTS

Temperature:	$>$-12 °C
Salinity:	Larvae can survive at $>$5 ppt. Adults can survive at $>$4 ppt and grow at $>$8 ppt.
pH:	Physiological processes occur without significant inhibition over a wide range of pH.

Habitat: Muddy sand or sandy mud, continuously burrowed

APPENDIX C

SEDIMENT QUALITY DATA

APPENDIX C: SEDIMENT QUALITY DATA

The sediment sampling data presented in this Appendix was collected by CENAB from a sampling station near Pooles Island during the Fall of 1995 (EA Engineering, 1996). This data collection effort is part of the annual sediment sampling and chemical analysis study for the Baltimore Harbor and Chesapeake Bay, Maryland. The sediment sampling data pertaining to Pooles Island is discussed in further detail in Section 4.2.2. The following table presents those metals detected at the sampling station near Pooles Island which have established no observable effect level (NOEL) and probable effects level (PEL) values. This Appendix also provides the raw sediment sampling data for the sampling station near Pooles Island. The sediment metals data referenced in Section 4.2.3 for the outer channels were taken from Versar, Inc. (1994) and can be found in this Appendix as well.

Metals Detected with Established NOEL and PEL Values

Metal Detected	Concentration At Sampling Station Near Pooles Island	Established NOEL Values	Established PEL Values
Arsenic	9.3	8	64
Cadmium	1.1	1	7.5
Chromium	26.5	33	240
Copper	14.6	28	270
Lead	16.3	21	160
Mercury	0.12	0.1	1.4
Zinc	94.1	68	300

NOEL and PEL values are from Eskin *et al.*, 1996. Concentrations are in mg/kg.

Volatiles results for sediment sampled near Pooles Island

Table 4-4. Continued.

POOLES ISLAND

Analyte	POLISED			
ug/kg	Result	Qual.	Dil.	Limit
1,1-Dichloroethane	ND		1x	1
1,1-Dichloroethene	ND		1x	1
1,1,1-Trichloroethane	ND		1x	0.8
1,1,2-Trichloroethane	ND		1x	2
1,1,2,2-Tetrachloroethane	ND		1x	1
1,2-Dichloroethane	ND		1x	2
1,2-Dichloropropane	ND		1x	2
2-Butanone	ND		1x	2
2-Chloroethyl vinyl ether	ND		1x	1
Acrolein	ND		1x	12
Acrylonitrile	ND		1x	8
Benzene	ND		1x	1
Bromodichloromethane	ND		1x	1
Bromoform	ND		1x	1
Bromomethane	ND		1x	1
Carbon tetrachloride	ND		1x	0.8
Chlorobenzene	ND		1x	0.8
Chloroethane	ND		1x	2
Chlororform	ND		1x	1
Chloromethane	ND		1x	2
cis-1,3-Dichloropropene	ND		1x	0.8
Dibromochloromethane	ND		1x	2
Dichlorodifluoromethane	ND		1x	2
Ethylbenzene	ND		1x	1
Methylene chloride	ND		1x	2
Tetrachlorethene	ND		1x	1
Toluene	ND		1x	0.8
trans-1,2-Dichloroethene	ND		1x	2
trans-1,3-Dichloropropene	ND		1x	1
Trichloroethene	ND		1x	0.8
Trichlorofluoromethane	ND		1x	1
Vinyl chloride	ND		1x	1

ND=Not detected

Semivolatiles results for sediment sampled near Pooles Island

Table 4-5. Continued

POOLES ISLAND

Analyte ug/kg	POLISED Result	Qual	Dil	Limit
1,2-Dichlorobenzene	ND		1x	480
1,2-Diphenylhydrazine	ND		1x	90
1,2,4-Trichlorobenzene	ND		1x	350
1,3-Dichlorobenzene	ND		1x	480
1,4-Dichlorobenzene	ND		1x	450
2-Chloronaphthalene	ND		1x	150
2-Chlorophenol	ND		1x	300
2-Methyl-4,6-dinitrophenol	ND		1x	160
2-Methylphenol	ND		1x	210
2-Nitroaniline	ND		1x	140
2-Nitrophenol	ND		1x	280
2,2'-oxybis(1-Chloropropane)	ND		1x	300
2,4-Dichlorophenol	ND		1x	150
2,4-Dimethylphenol	ND		1x	400
2,4-Dinitrophenol	ND		1x	280
2,4-Dinitrotoluene	ND		1x	130
2,4,5-Trichlorophenol	ND		1x	80
2,4,6-Trichlorophenol	ND		1x	150
2,6-Dinitrotoluene	ND		1x	180
3-Nitroaniline	ND		1x	530
3+4-Methylphenol	ND		1x	200
3,3'-Dichlorobenzidine	ND		1x	720
4-Bromophenyl phenyl ether	ND		1x	78
4-Chloro-3-methylphenol	ND		1x	120
4-Chloroaniline	ND		1x	660
4-Chlorophenyl phenyl ether	ND		1x	160
4-Nitroaniline	ND		1x	220
4-Nitrophenol	ND		1x	160
Benzidine	ND		1x	700
Benzoic acid	ND		1x	960
Benzyl alcohol	ND		1x	220
Benzyl butyl phthalate	ND		1x	220
bis(2-Chloroethoxy)methane	ND		1x	200
bis(2-Chloroethyl) ether	ND		1x	[illegible]
bis(2-Ethylhexyl) phthalate	ND		1x	320

analyte list continued on following page

ND=Not detected

Semivolatiles results for sediment sampled near Pooles Island

Table 4-5. Continued

POOLES ISLAND

Analyte ug/kg	POLISED Result	Qual	Dil	Limit
Carbazole	ND		1x	120
Cyclohexanone	ND		1x	500
Dibenzofuran	ND		1x	110
Diethyl phthalate	ND		1x	120
Dimethyl phthalate	ND		1x	100
Di-n-butyl phthalate	ND		1x	120
Di-n-octyl phthalate	ND		1x	85
Hexachlorobenzene	ND		1x	150
Hexachlorobutadiene	ND		1x	380
Hexachlorocyclopentadiene	ND		1x	180
Hexachloroethane	ND		1x	450
Isophorone	ND		1x	190
Nitrobenzene	ND		1x	300
N-Nitrosodimethylamine	ND		1x	400
N-Nitrosodi-n-propylamine	ND		1x	200
N-Nitrosodiphenylamine	ND		1x	150
Pentachlorophenol	ND		1x	170
Phenol	ND		1x	230
Pyridine	ND		1x	300

Semivolatile polynuclear aromatic hydrocarbons (PAHs) results for sediment sampled near Pooles Island

Table 4-6. Continued.

POOLES ISLAND

Analyte ug/kg	POLISED Result	Qual.	Dil.	Limit
1-Methylnaphthalene	ND		1x	35
2-Methylnaphthalene	ND		1x	35
Acenaphthene	ND		1x	35
Acenaphthylene	ND		1x	59
Anthracene	ND		1x	3.5
Benzo[a]pyrene	ND		1x	4.7
Benzo[b]fluoranthene	59		1x	4.1
Benzo[g,h,i]perylene	ND		1x	4.7
Benzo[k]fluoranthene	ND		1x	2.1
Benz[a]anthracene	ND		1x	1.7
Chrysene	ND		1x	2.2
Dibenz[a,h]anthracene	ND		1x	2.4
Fluoranthene	ND		1x	4.7
Fluorene	ND		1x	7.2
Indeno[1,2,3-cd]pyrene	ND		1x	4
Naphthalene	ND		1x	35
Phenanthrene	5.8		1x	1.6
Pyrene	ND		1x	4.4

ND= Not detected

Pesticide and PCB results for sediment sampled near Pooles Island

Table 4-7. Continued.

POOLES ISLAND

Analyte	POLISED			
ug/kg	Result	Qual	Dil.	Limit
4,4'-DDD	ND		1x	3.5
4,4'-DDE	ND		1x	0.72
4,4'-DDT	ND		1x	4
Aldrin	ND		1x	0.4
alpha-BHC	ND		1x	2.8
Azinphos methyl	ND		1x	2
beta-BHC	ND		1x	0.25
Chlordane, technical	ND		1x	9.2
Chlorobenside	ND		1x	17
Dacthal	ND		1x	17
delta-BHC	ND		1x	0.42
Demeton	ND		1x	2
Dieldrin	ND		1x	3.2
Endosulfan I	ND		1x	0.25
Endosulfan II	ND		1x	0.57
Endosulfan sulfate	ND		1x	1.3
Endrin	ND		1x	3.5
Endrin aldehyde	ND		1x	0.25
Ethyl parathion	ND		1x	17
gamma-BHC	ND		1x	1.8
Heptachlor	ND		1x	2.1
Heptachlor epoxide	ND		1x	0.25
Malathion	ND		1x	17
Methoxychlor	ND		1x	30
Methyl parathion	ND		1x	17
Mirex	ND		1x	17
Toxaphene	ND		1x	130
Aroclor-1016	ND		1x	9.9
Aroclor-1221	ND		1x	25
Aroclor-1232	ND		1x	7.4
Aroclor-1242	ND		1x	9.9
Aroclor-1248	ND		1x	2.5
Aroclor-1254	ND		1x	4.9
Aroclor-1260	ND		1x	2.5

ND=Not detected

Metals results for sediment sampled near Pooles Island

Table 4-8. Continued.

POOLES ISLAND

Analyte	POL1SED			
mg/kg	Result	Qual.	Dil.	Limit
Aluminum	17800		1x	6.2
Antimony	ND	N	1x	0.21
Arsenic	9.3		1x	0.21
Beryllium	1	B	1x	0.21
Cadmium	1.1		1x	0.21
Chromium	26.5		1x	1.1
Copper	14.6		1x	0.85
Iron	35100		1x	13.4
Lead	16.3		1x	0.21
Manganese	1290		1x	1.1
Mercury	0.12	B	1x	0.12
Nickel	30.6		1x	1.9
Selenium	1	B	1x	0.43
Silver	ND		1x	0.64
Thallium	ND		1x	0.4
Zinc	94.1		1x	1.3

ND= Not detected N=MS outside of control limits
B=Between IDL and CRDL

General chemistry results for sediment sampled near Pooles Island

Table 4-10. Continued.

POOLES ISLAND

Analyte mg/kg	POLISED Result	Qual	Dil	Limit
Carbon, total organic	36100		1x	1100
Cyanide, total	ND		1x	0.53
Nitrogen, ammonia	39.7		1x	6.6
Nitrogen, nitrate and nitrite	7.5		1x	2.4
Nitrogen, total Kjeldahl	982		1x	322
Oxygen demand, biochemical	1080		1x	296
Oxygen demand, chemical	88200		1x	988
Phosphorus, total	467		1x	30.9
Sulfide, total	ND		1x	47.5

ND=Not detected

Grain size, Atterberg Limits, and percent moisture results for sediment sampled near Pooles Island

Table 4-11. Continued.

	DEEP TROUGH			KENT ISLAND DEEP			POOLES ISLAND
Physical Analyses	DT1SED	DT2SED	DT3SED	KI1SED	KI2SED	KI3SED	POL1SED
Grain Size							
% gravel	0	0	0	1.4	0	0.4	0
% sand	0.9	22.4	0.6	93.1	7.9	90.8	5.1
% silt	14.9	53.9	19.1	3.5	17.9	0.7	23.8
% clay	84.2	23.7	80.3	2	74.2	8.1	71.1
Atterberg Limits							
Liquid Limit (LL)	148	88	112	NP	102	NP	128
Plasticity Index (PI)	94	53	53	NP	57	NP	82
Percent Moisture (%)	78.9	58.1	81.8	24.7	67.8	25.9	61.0

NP=Non-plastic

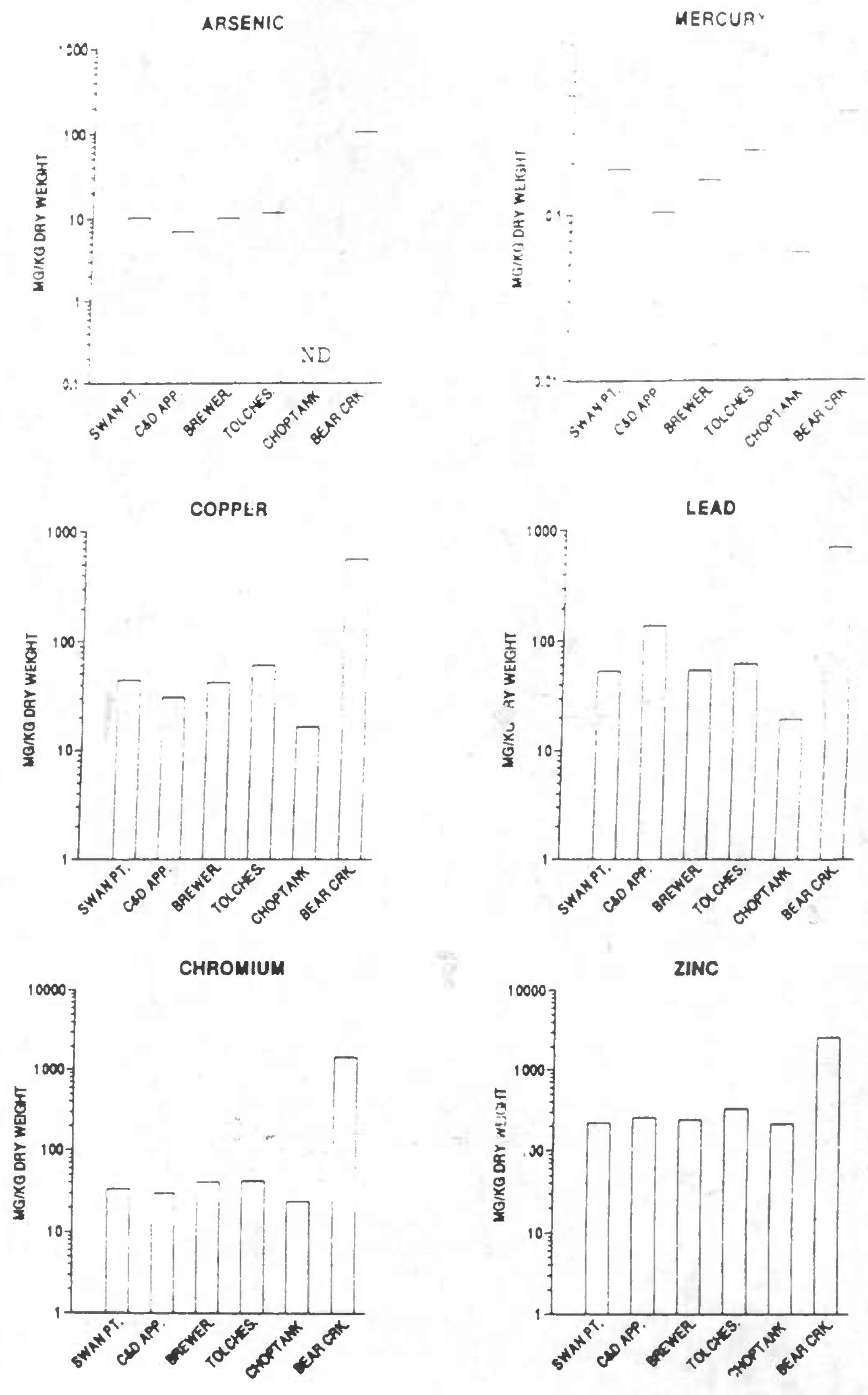


Figure 4-1. Comparison of metals concentration (average mg/kg dry weight) in the Swan Point, C&D Approach, Brewerton, and Tolchester Channels relative to the Choptank River and Bear Creek stations; **note that the graphs have a logarithmic scale.**

Table 4-2. Comparison of metal concentrations in four approach channels with sediment guidance values (mg/kg dry wt)

	Mean Sediment Concentrations				Guidance Values			
	Brewerton	C & D	Swan Point	Tolchester	Overall Apparent Effects Threshold	Maryland Draft Guidelines	Effects Range Low	Effects Range Medium
Arsenic	11.3	7.1	10.3	11.7	50	--	33	85
Chromium	40.6	29.3	33.8	42.4	--	80	80	145
Copper	42.8	31.0	43.8	61.5	300	80	70	390
Lead	53.4	139.5	52.3	61.8	300	100	35	110
Mercury	0.18	0.11	0.20	0.25	1	1	0.15	1.3
Zinc	240.7	255.0	219.2	328.2	260	300	120	270

APPENDIX D

COMMENTS RECEIVED ON DRAFT ENVIRONMENTAL ASSESSMENT

COMMENTS RECEIVED ON DRAFT ENVIRONMENTAL ASSESSMENT

INSERT COMMENT LETTERS
(CHECK TABLE OF CONTENTS FOR THIS
APPENDIX FOR ACCURACY)